TYPE 74-13A

Calibrated Delaying Sweep Plug-in

INSTRUCTION MANUAL

DUMONT

OSCILLOSCOPE LABORATORIES, INC.

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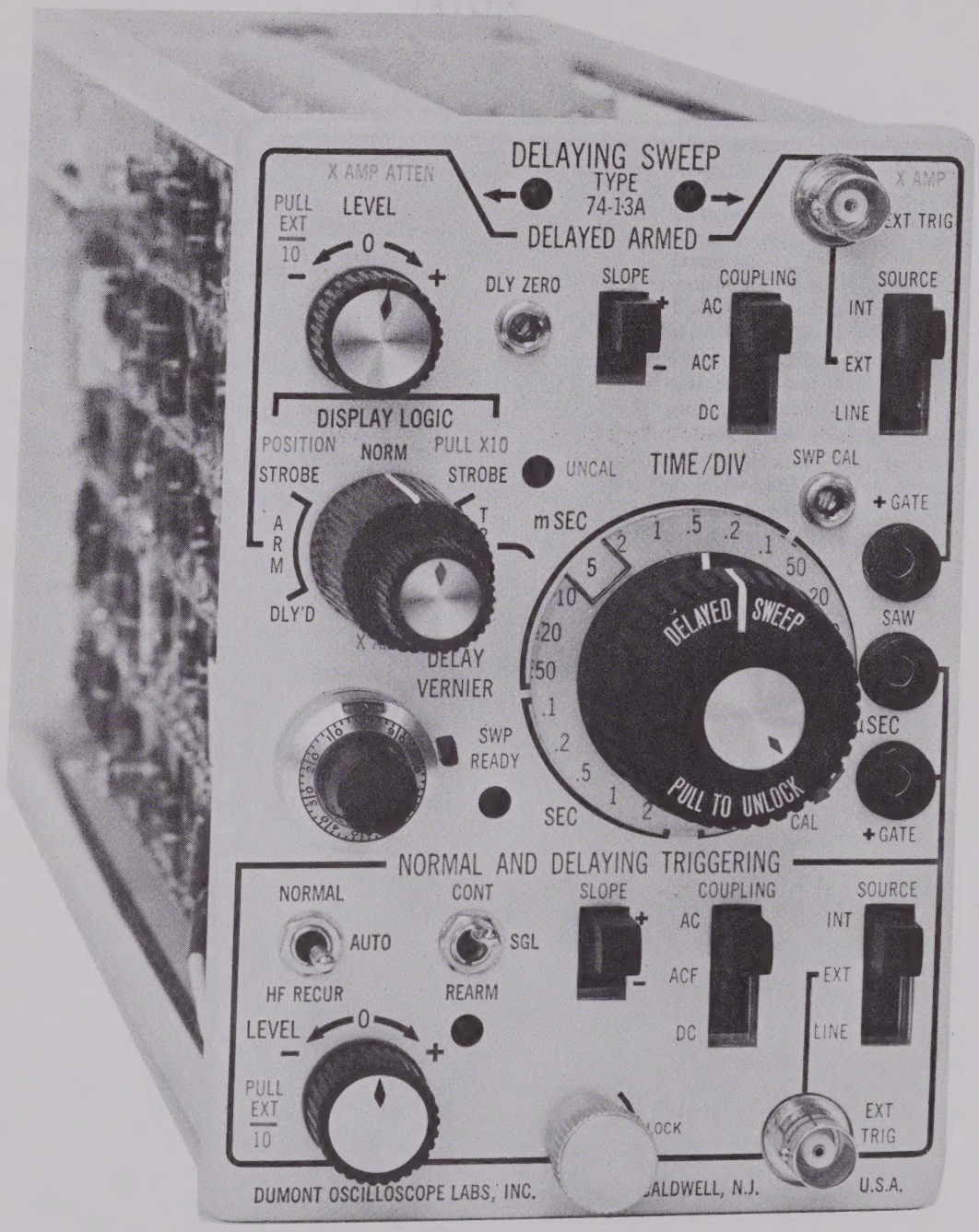


Figure 1-1. Type 74-13A Calibrated Delaying Sweep Plug-In

SECTION 1
TECHNICAL SUMMARY

1-1. INTRODUCTION

PLEASE NOTE

IMPORTANT INITIAL ADJUSTMENTS MUST BE MADE BEFORE OPERATING THIS PLUG-IN MODULE. See Paragraph 2-1 entitled "First Time Operation" in Section 2 for instructions.

The Type 74-13A Dual Time Base Calibrated Delaying Sweep is designed for use with the Dumont Type 765/765H Series of Transistorized Oscilloscopes.

To simplify circuit description, the following abbreviations are employed to describe the dual time base delaying sweeps.

Abbreviation	Description
NDT	The NDT sweep refers to Normal Sweep operation and Delaying Triggered operation (i.e., the delayed sweep starts immediately after the delay pick-off trigger is generated).
DA	The DA sweep refers to Delayed Armed operation (i.e., the delaying sweep (NDT) generates a delay pick-off trigger which arms the DA sweep). An input trigger signal is then required to fire the DA sweep.

1-2. TECHNICAL SUMMARY

The performance specification of this plug-in module is given in the technical summary which follows.

section 1 — technical summary

TIME BASE SYSTEM

Calibrated Sweep Range (NDT & DA)

Calibrated linear sweep rates from 0.1 μsec/div to 2 sec/div in 23 steps of 1, 2, and 5 sequence

Uncalibrated Sweep Range

The Sweep Vernier control provides a continuous uncalibrated range of sweep rates between ranges and extends the 2 sec/div range to 5 sec/div (50 seconds full scale). The UNCAL lamp serves as an indicator of uncalibrated or vernier operation

Sweep Accuracy

±3% measured over the centered 8 div portion of the CRT screen

Sweep Range Indicator

Push-pull clutch knob permits simultaneous or independent control of the NDT and DA sweep rates

Sweep Expander

A calibrated X10 sweep expander in the X output amplifier will expand the sweep about screen center; extends fastest sweep rate to 10 nanoseconds/div. Expander accuracy is ±5% for speeds faster than 200 nanoseconds/div and ±3% for slower sweeps. Neglect the first 50 nanoseconds

Sweep Calibration

A front-panel screwdriver SWP CAL control is provided to permit normalization of the plug-in unit to the Main Frame and standardizing the sweeps to an external time standard

Gate Out (NDT & DA)

Two front-panel banana jacks each provide a positive-going pulse of 2.5 volts nominal. Output impedance is 500 ohms. For optimum performance, load impedance should be greater than 100K ohms and shunted by less than 15 pf. Gate is referenced directly to ground and is time-coincident with the sweep

Saw

Panel banana jack provides a positive saw output of approximately 25 volts and is coincident with the NDT Sweep. Output impedance is nominally 10K ohms, and load impedance should be greater than 100K ohms shunted by less than 15 pf

Other Controls

Internal controls optimize settings of automatic strobe intensity and strobe transition. This normalizes the plug-in to the CRT of the Main Frame and avoids having to reset the intensity control when observing strobed display modes

SWEEP MODES

Normal Sweep Operation

Conventional sweep display. Internally or externally applied trigger signals drive the NDT time base circuit

Delayed-Triggered Strobe

Delaying sweep display showing the delayed sweep as a brightened sector. The delayed sweep starts immediately after the delay pick-off trigger is generated

Delayed-Armed Strobe

Delaying sweep display showing the delayed sweep as a brightened sector, but delayed sweep (brightened sector) is armed by the delayed trigger and initiated by a sync trigger

The delayed sweep automatically shuts off when the delaying sweep is terminated. This prevents brightening of the sweep retrace in either STROBE position

Delayed Triggered or Delayed Armed

The brightened sector of the strobe sweep displays are expanded to full scale in either of the DELAYED modes. Automatic provision is made for shut-off of the delaying sweep (NDT) when the delayed sweep (DA) is terminated. This permits maximum duty cycle performance in the DELAYED mode

Single Sweep

The single sweep mode permits but one driven sweep of the time base to appear on the screen until the delayed sweep (DA) is reset or rearmed

The single sweep may be rearmed with a single external trigger pulse, by turning the NDT Trigger Level control or by switching the NDT trigger polarity switch

The SWP READY indicator is lit whenever the delayed sweep gate multivibrator is armed and ready to be triggered

X Amplifier (for X-Y Displays)

When the DISPLAY LOGIC switch is set to X AMP, X Input signals may be applied to X Amplifier via EXT setting of the Trigger SOURCE switch and preferably "−Slope"

CALIBRATED DELAY TIME SYSTEM

Delay Vernier Control

A ten-turn precision potentiometer determines the on-screen distance from the delaying sweep (NDT) start at which the delayed sweep is either triggered or armed

CALIBRATED DELAY TIME SYSTEM (Concluded)

The DELAY VERNIER control is calibrated to read from zero to 10 divisions. This control functions as a Delay Multiplier when used in conjunction with the Delayed TIME/DIV control

Accuracy

Incremental accuracy of the ten-turn calibrated control is within ±0.25%

Delay Zero Control

Zero delay is adjustable from the front panel. For extreme accuracy, any or all steps can be adjusted to an external standard from the front panel

Delay Range

From a minimum of ¼ microsecond to more than 20 seconds

TRIGGERING SYSTEM

(Separate facilities for each Time Base are provided)

HF Recur

A unique high-frequency stability switch may be used to improve count down and lock-in of signals having repetition rate of 5 Mc or greater. It provides stable synchronization of signals of 1 cm deflection to beyond 50 Mc

Internal Trigger

Signals will trigger from 0.5 div of Y signal up to 1 Mc; from 1 div of Y signal up to 10 Mc with Types 76-01A, 76-02A, 76-03 and 76-08 Modules in Y cavity. With the HF STAB control set to RECUR, adjustment of the Trigger LEVEL and HF STAB controls will produce a stable display with 0.2 division of Y signal at 1 Mc and 2 divisions of Y signal at 30 Mc

External Trigger (X1)

0.5 volt peak-to-peak from dc to 1 Mc will trigger the sweep; 1 volt peak-to-peak will trigger the sweep to 10 Mc. Trigger leveling, slope selection and ac or dc coupling are included. With the HF STAB control set to RECUR, adjustment of the Trigger LEVEL control will produce a stable display with 0.2V to 10V input at 1 Mc

External Trigger (X10)

Same frequency limits as external trigger X1; a 10:1 attenuator is provided to extend the dc leveling capability to ±100 volts dc

Trigger Level

A range of ±10 volts (nominal) with respect to ground on external triggering

Trigger Slope

Selection of positive or negative slopes on Internal, Line, or External triggering is available

Line Trigger

Line frequency triggering can be selected in either polarity and the triggering point may be shifted with the Trig LEVEL control

Ext Trig Input Impedance

1 megohm shunted by 40 pf (nominal)

AC Coupling

High-pass filter with low-frequency cutoff of 80 cycles

DC Coupling

Direct coupling is provided to optimize trigger sensitivity when very slow waveforms are applied; to maintain the initial reference position of the trace with respect to the CRT scale at a given trigger level setting; and to avoid trigger point variations due to random repetition rate trigger signals

ACF

Differentiated trigger input; high-pass filter is provided to reject hum and low-frequency amplitude modulation; low-frequency cutoff nominally 10 Kc. Signals should rise or fall in less than 100 μsec to pass the LF reject filter

Automatic Triggering

Visible base line on all sweep ranges when there is no signal input. The sweep free runs until a trigger signal of 20 cps to 10 Mc is applied. Application ot a trigger signal switches the sweep to the triggered mode immediately

Single Sweep

Allows one sweep to occur

HORIZONTAL DEFLECTION SYSTEM

Bandwidth

Direct Coupled: DC to 2 Mc; down 3 db at 2 Mc

Capacitively Coupled: Low-frequency cutoff is 80 cycles

Sensitivity (X10 Expansion)

EXT/X1 Range: 0.1 volt/div
EXT/X10 Range: 1 volt/div

X Vernier: A ten-to-one attenuator is provided in the horizontal deflection channel to extend the input signal range to 10 volts/div

Sensitivity (X1 Expansion)

Reduces all above sensitivities by 10:1 (Restricted scan)

HORIZONTAL DEFLECTION SYSTEM (Concluded)

Input Impedance

1 megohm shunted by 40 pf (nominal)

Input Connector

X AMP front-panel connector is provided to permit use of the horizontal deflection amplifier for X-Y displays. (DA EXT TRIG connector serves this dual purpose)

X Positioning

A front-panel control permits coarse and fine positioning of the X Input signal or any portion of the sweep to within two divisions of screen center

Beam Position Indicators

Two indicator lamps are located on the front panel to alert the operator as to the direction of the beam when it is positioned off the screen

SECTION 2
OPERATING INSTRUCTIONS

2-1. FIRST TIME OPERATION (Figures 2-1 to 2-4)

If this is the first time these plug-ins have ever been used, then certain initial adjustments must be made. For instructions, refer to Section 5, Maintenance and Recalibration and to the paragraph indicated, and make the following adjustments.

Adjustment	Paragraph
NDT Sweep Length	5-9
Sweep Cal	5-10
DA Sweep Length	5-11
Strobe Intensity and Pattern Correction	5-17
Delay Zero Adjustment	5-18
Delay Cal Adjustment	5-19

The following illustrations are designed to aid the operator in becoming familiar with the Delaying Sweep Plug-ins.

Figures 2-1a & 2-1b	Type 74-13A, Function of Controls and Connectors
Figure 2-2	Type 74-13A, Normal Display
Figure 2-3a	Type 74-13A, Triggered Strobe Display
Figure 2-3b	Type 74-13A, Delayed Triggered Display
Figure 2-4a	Type 74-13A, Armed Strobe Display
Figure 2-4b	Type 74-13A, Armed Delayed Display

Unless otherwise designated, it is presumed that a Y Amplifier Plug-in module is inserted in the Y cavity (left-hand side) and the Type 74-13A Time Base Plug-in unit is inserted in the X cavity (right-hand side) of the Main Frame.

We know that you are anxious to get acquainted with your new instrument. To aid you in this endeavor, you may set up the instrument using the built-in calibrator signal to demonstrate the effects of the various controls on the display.

2-2. SWEEP TRIGGERING

Two trigger circuits are built into the Delaying Sweep plug-ins. Each Time Base is provided with its own separate triggering facility.

To obtain a stable display, the sweep must consistently start at the same time relative to recurring cycles of the input waveform. If the sweep is allowed to occur at random or at a rate unrelated to the rate of occurrence of the input waveform, the displayed pattern will be traced out at a different point on the screen each time the sweep runs. This will either cause the waveform to drift across the screen or to be unintelligible. The sweep therefore must be triggered by the input signal, or by some signal which bears a fixed time relationship to the input signal. For present purposes, the starting of each horizontal waveform across the screen may be called "triggering the sweep." The following instructions tell you how to select and use the proper triggering signal for various applications.

2-3. TRIGGER SOURCE SELECTION

a. Internal

For most applications, the sweep may be triggered by the Y input signal. The only requirement is that the signal amplitude be sufficient to trigger the sweep. To obtain triggering of the sweep from the input signal, set the Trigger SOURCE switch to INT. Internal triggering is convenient since no external triggering connections are required. Satisfactory results are obtained in most applications.

b. External

Sometimes it is advantageous to trigger the sweep with an external signal. External triggering is especially useful where signals are going to be sampled from several different places within an instrument. With external triggering, the triggering signal usually remains constant in amplitude and shape. Thus, it is possible to observe the shaping and amplification of a signal in an external circuit without resetting the oscilloscope triggering controls for each observation. Also, time and phase relationships between the waveforms at different points in the circuit can be seen. For example, if the external triggering signal is derived from the waveform at the input to a circuit, the time relationship and phase of the waveforms at each point in the circuit are compared to the input signal by the displayed waveform.

When a stable, external triggering signal is available, it is possible to observe and accurately measure jitter of the displayed waveform with respect to the trigger input signal. This is not possible when the sweep is triggered internally. A trigger preceding the signal may be used to externally trigger the oscilloscope to display the entire signal.

External triggering should also be used with a dual-trace amplifier module in the ALTernate mode to show the proper time relationship between the two displayed signals. To obtain a stable display, the external triggering signal must have an amplitude of at

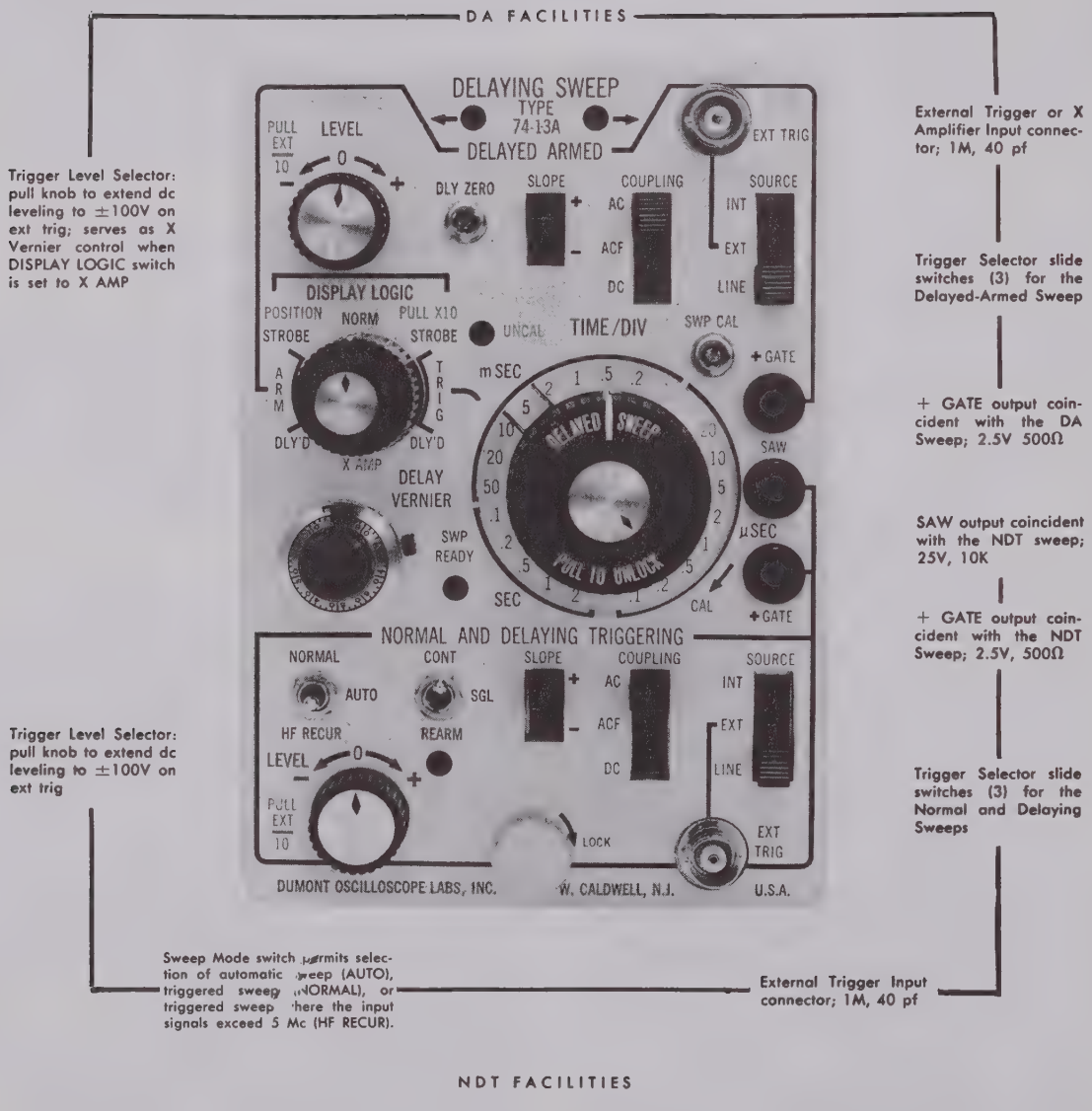
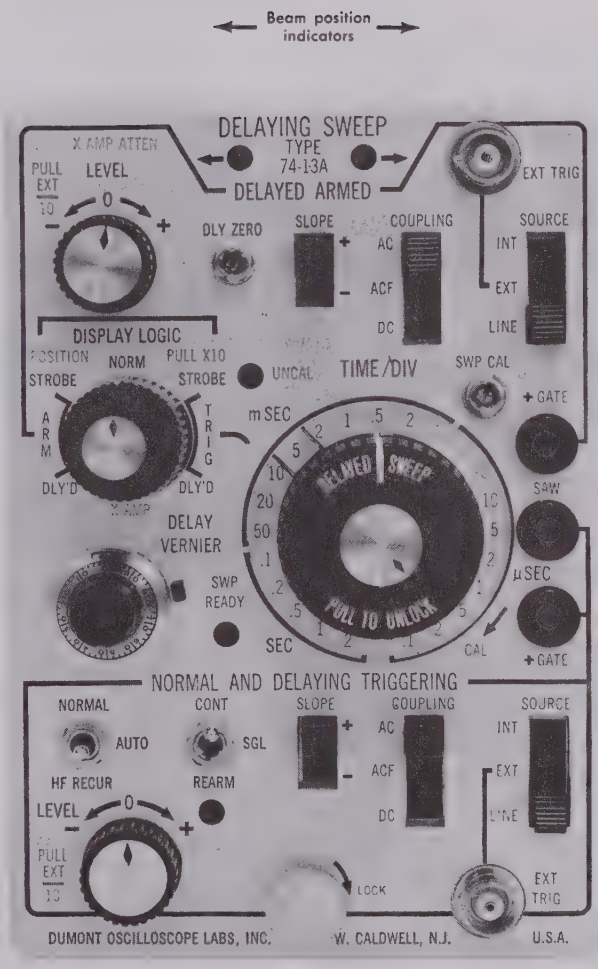


Figure 2-1a. Type 74-13A Function of Controls and Connectors



DELAY ZERO control permits precise DELAY VERNIER zero adjustment

DISPLAY LOGIC switch determines sweep operational modes; see text for details

Concentric control positions normal or expanded display on screen; pull knob for 10X mag of display

DELAY VERNIER control determines the on-screen distance from the normal sweep start at which the delayed sweep is either triggered or armed; functions as an accurate delay multiplier when used with the DA TIME/DIV switch

SWEEP CAL control normalizes the Plug-in to Main Frame

NDT & DA TIME/DIV Selector switches: knobs may be rotated together or the DA sweep knob can be disengaged and rotated separately; concentric knob provides vernier sweep operation (UNCAL lamp lights)

Mode switch selects continuous (CONT) sweep or single (SGL) sweep. Also rearms (REARM) single sweep.

SWEEP READY lamp indicates DA Sweep is armed and ready to be triggered

Figure 2-1b. Type 74-13A Function of Controls and Connectors

least 0.5 volt, peak-to-yeak (1 mc) and bear a fixed time relationship to the displayed signal. To use an external signal for triggering the sweep, connect the signal to the EXT TRIG connector and set the Trigger SOURCE switch to EXT.

c. Line

If the pattern on display bears a fixed time relationship to the power-line frequency, the sweep may be triggered by this signal. To accomplish this, set the Trigger SOURCE switch to LINE. Always use dc coupling mode with LINE Trigger Source.

2-4. TRIGGER COUPLING SELECTION

a. AC Coupling

Selection of the AC triggering mode is accomplished by setting the COUPLING switch to AC. This mode is provided with a high-pass filter that has a low-frequency cutoff nominally at 80 cycles. This feature prevents erratic triggering when positioning the pattern vertically and using internal triggering. In the AC mode, triggering is unaffected by the dc components of the triggering signal or by the vertical positioning of the trace. The triggering level can be selected to provide the desired display via use of the Trig LEVEL control.

When using the AC mode, the Trigger COUPLING switch is set to AC. The trace always starts at the same point on the *Waveform* for a given Trig LEVEL control setting regardless of the vertical positioning.

Note: AC coupling triggering on the line-frequency calibrator signal or square wave signals less than 100 cycles, may be erratic since the 80-cycle cutoff filter severely integrates the trigger. DC coupling is recommended for these signals.

b. DC Coupling

The DC mode is especially useful for viewing waveforms which change very slowly and which are therefore discriminated against by the low-frequency cutoff of the AC position (80 cps). Because of the coupling network time constant in the AC mode, signals having random repetition rates are sometimes viewed more stably in the DC mode. This mode permits excellent triggering on all types of waveforms and is most useful in the following applications:

1. For optimizing trigger sensitivity or operation when low-frequency signals are applied;

2. For maintaining the initial reference position of the trace with respect to the CRT scale at a given TRIG LEVEL control setting when on Internal source; and

3. For avoiding trigger point variations due to random repetition rate triggering signals.

When using the DC mode, the Trigger COUPLING switch is set to DC. When using internal source, the trace always starts at the same point on the *Scale* for a given setting of the Trig LEVEL control regardless of the vertical positioning.

c. ACF Coupling

The ACF mode is a special high-frequency form of the AC mode and is used to reject low-frequency components in the triggering signal. Use AC triggering unless low-frequency rejection is required. Triggering signals with frequency components below 10 Kc, for example the calibrator signal, may not initiate the sweep circuits when the ACF mode is used. *Also, the ACF mode will assure stable triggering from the dual-trace plug-in when it is set up for alternate sweep mode, and using internal trigger source.* Thus the ACF mode prevents the difference in positioning level of the two channels from interfering with stable triggering.

Signals must have rise or fall times faster than 10 μsec when using the ACF mode. If slower dual time signals are to be displayed, use external triggering. Note that the Type 76-08 and other multi-trace plug-ins are provided with a selector switch which permits triggering from one channel only. Therefore the ACF electronic switch mode no longer applies.

Occasionally it is required to obtain stable triggering from a complex high-frequency waveform that contains undesirable low-frequency noise or line-frequency components. In such cases, the additional noise and line pickup may make it difficult to obtain a stable display. If this occurs, select the ACF triggering mode, thereby eliminating the effects of these undesired components. The low-frequency components are blocked from the triggering circuit while the high-frequency triggering waveform is passed to produce the stable triggering that is required. In all other respects, the ACF triggering mode is identical to the AC mode.

2-5. TRIGGER SLOPE SELECTION

When the Trigger SLOPE switch is set to +, the sweep is triggered on the rising or positive slope of the excitation signal. When the Trigger SLOPE switch is set to −, the sweep is triggered on the falling or negative slope of the excitation signal.

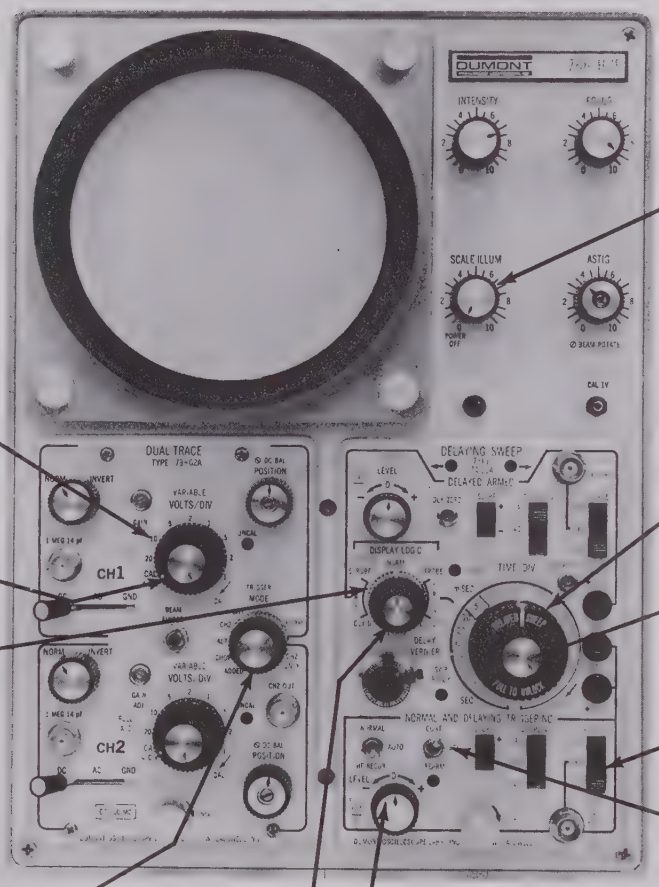
2-6. TRIGGER LEVEL SELECTION

The Trig LEVEL control permits selection of a specific voltage which the triggering signal must exceed before the sweep fires. When the Trigger SLOPE switch is set to the + position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently on the positive slope of the ex-

NORMAL SWEEP DISPLAY OF CAL SIGNAL

To obtain the calibrator display using NORMAL sweep, set the controls exactly as shown and perform the numbered steps in sequence.

Use the same procedure when difficulty is experienced in obtaining a display. This will eliminate "cockpit" troubles due to misalignment of controls.



Set ASTIG, FOCUS, & INTENSITY controls to center of range

1 Rotate clockwise to turn on the oscilloscope

2 *Set TIME/DIV knob (outer) to 5 mSEC

3 Set VERNIER fully clockwise

4 Set switches to: + AC & LINE

5 Set to CONT

6 Set to Zero

7 Set outer knob (VOLTS/DIV) to CAL

8 Rotate inner knob (VARIABLE) fully clockwise

9 Set outer knob (DISPLAY LOGIC) to NORMAL

10 Set MODE switch to NORM

11 Adjust to center the display horizontally

Readjust (POSITION) control on the Y Amplifier to center display vertically

Readjust INTENSITY, FOCUS & ASTIG controls for a sharp pattern

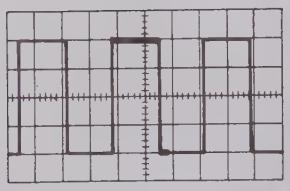
*The TIME/DIV "clutched knobs" are engaged when the notch on the plastic skirt is aligned with the white pointer on the clutched knob

Figure 2-2. Type 74-13A Normal Display

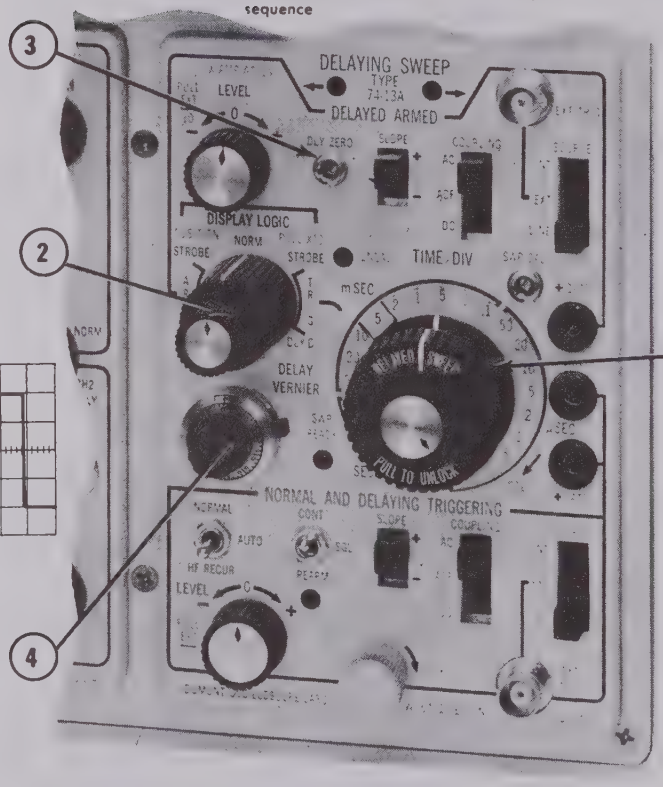
This is a continuation of the initial setup of Figure 2-2. Set the controls exactly as shown and perform the numbered steps in sequence

Set DELAY VERNIER dial to 0 and adjust the DELAY ZERO control until the strobe just disappears on the left hand side of the trace. This operation calibrates the DELAY VERNIER dial

Set the DISPLAY LOGIC switch to Triggered STROBE



Set DELAY VERNIER dial to 3. The portion of the display between 3 and 5 divisions of the start of the Normal Sweep should be brighter than the rest of the displa·



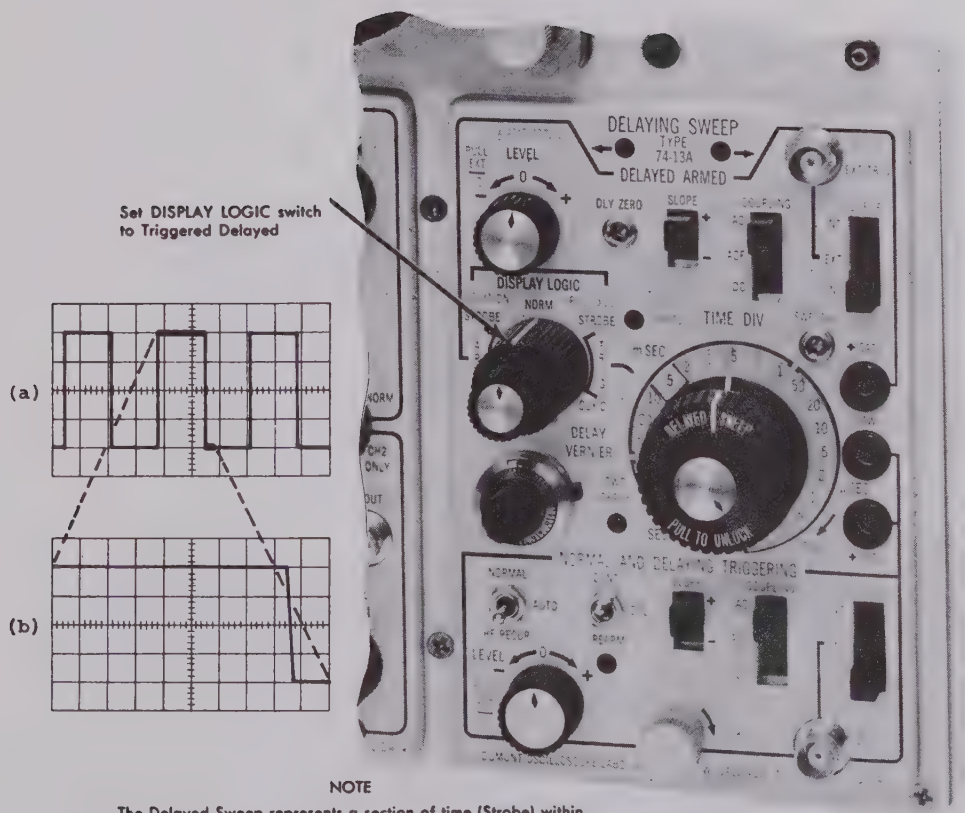
Pull out knob to disengage and rotate two steps to the right (1 mSEC). The knob with plastic skirt should be pointing to 5 mSEC

NOTE

The amount of delay occurring from the application of the triggering signal until the Delayed Sweep starts, is indicated directly by the setting of the NDT TIME/DIV switch (plastic skirt) and DELAY VERNIER dial. In this instance, the NDT sweep rate of 5 mSec/Div is multiplied by the DELAY VERNIER dial setting of 3 div yielding a calibrated delay time of 15 milliseconds. The above applies only when the delayed-triggered operational mode is used.

Figure 2-3a. Type 74-13A Triggered Strobe Display

DISPLAY OF CAL SIGNAL



(a) Trace intensified by use of delayed sweep

(b) Expanded presentation of the intensified pattern

NOTE

The Delayed Sweep represents a section of time (Strobe) within the normal sweep display and this section may be expanded to full scale. Hence the delayed sweep may be considered as a calibrated, magnified section of the NDT sweep. The magnification ratio may be expressed:

$$\frac{\text{NDT Sweep Rate}}{\text{DA Sweep Rate}}$$

In this instance we have: $\frac{5\ \text{mSEC/DIV}}{1\ \text{mSEC/DIV}} = 5$

Figure 2-3b. Type 74-13A Delayed Triggered Display

This is a continuation of the initial setup of Figure 2-3b. Set the controls exactly as shown and perform the numbered steps in sequence

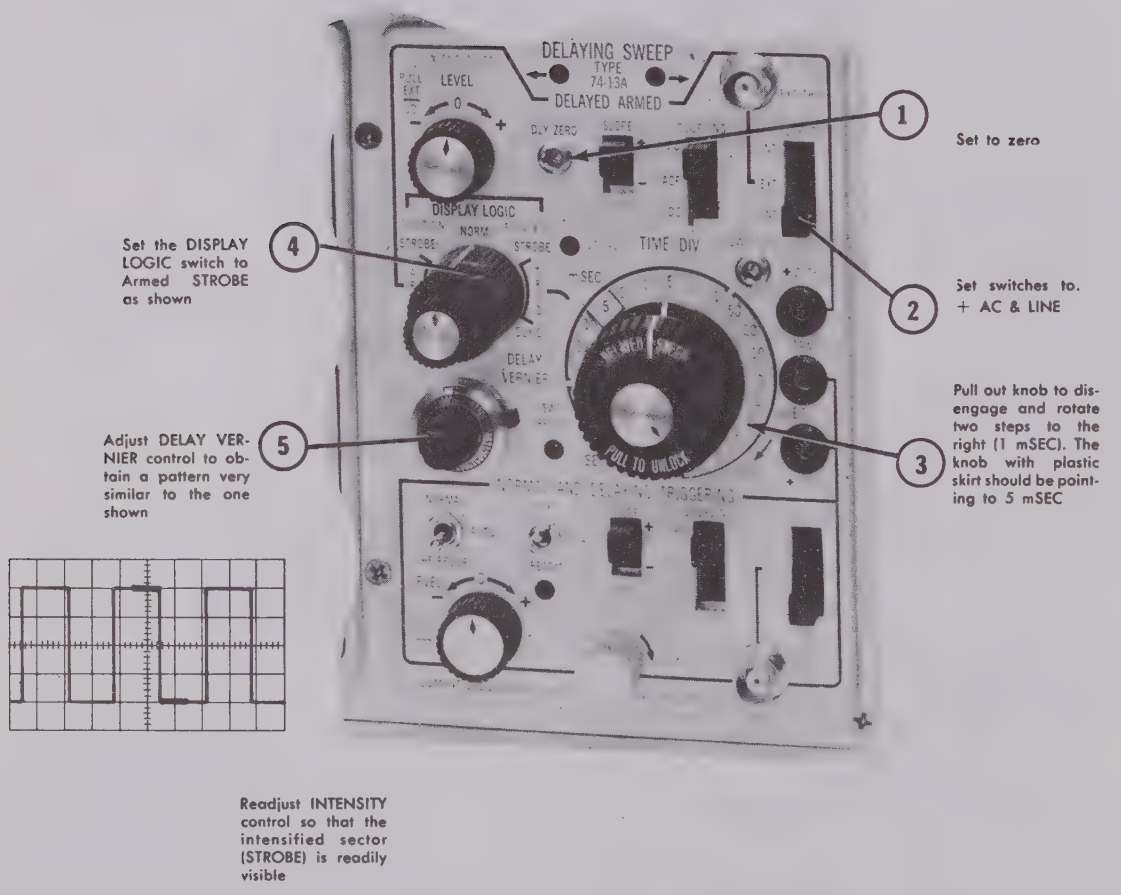
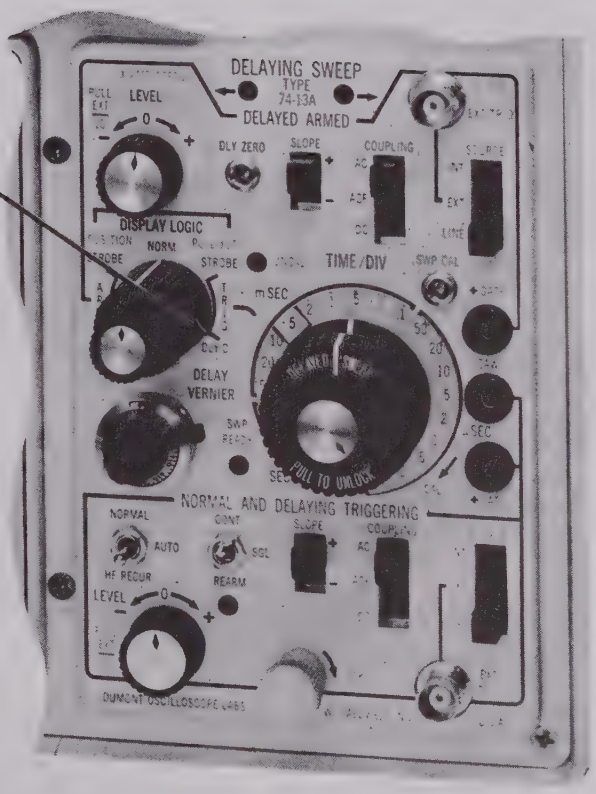
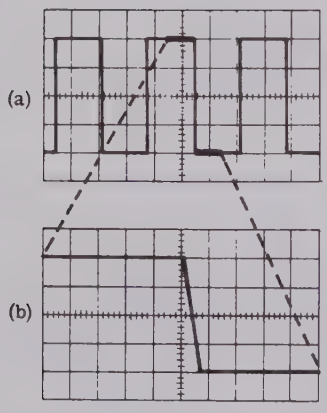

DELAYING SWEEP
TYPE 74-13A
DELAYED ARMED
LEVEL
DISPLAY LOGIC
TIME DIV
PULL TO UNLOCK
1
Set to zero
2
Set switches to. + AC & LINE
3
Pull out knob to disengage and rotate two steps to the right (1 mSEC). The knob with plastic skirt should be pointing to 5 mSEC
4
Set the DISPLAY LOGIC switch to Armed STROBE as shown
5
Adjust DELAY VERNIER control to obtain a pattern very similar to the one shown
Readjust INTENSITY control so that the intensified sector (STROBE) is readily visible

Figure 2-4a. Type 74-13A Armed Strobe Display

DISPLAY OF CAL SIGNAL

Set DISPLAY LOGIC switch to Armed DELAY. The brightened portion of the original display (a) will now be expanded to fill the entire scale as indicated in (b). In this example, the magnification ratio is 5 to 1





In the delay-armed mode, the Delayed Sweep does not start precisely at the delay time indicated by the operator, but instead is initiated by the next suitable trigger following the delay interval. Since the sweep is triggered by the input signal, jitter is eliminated from the display even though it is inherent in the input waveform.

Figure 2-4b. Type 74-13A Armed Delayed Display

citation signal. Conversely, with the Trigger SLOPE switch set to the − position, adjustment of the Trig LEVEL control makes it possible to trigger the sweep consistently on the negative slope of the excitation signal. Normal trigger level range is ±10 volts. This may be extended to ±100 volts on external source by pulling the Trigger LEVEL knob into EXT/10 position.

2-7. SWEEP OPERATIONAL MODES

a. Introduction

When using the Delaying Sweep Time Base Plug-in, the start of the horizontal sweep can be delayed for a period of from ¼ microsecond to 20 seconds after application of the triggering waveform. This is accomplished through simultaneous use of the NDT Time Base and the DA Time Base. In this application, the NDT Time Base is used to provide the accurate time delay while the DA Time Base provides a normal horizontal sweep at the end of the delay period. The duration of the sweep delay is controlled by the NDT TIME/DIV and the DELAY VERNIER control settings.

The delayed sweep feature of this instrument may be employed in a number of special applications to increase its versatility. Such applications include high magnification of a selected portion of an undelayed sweep, accurate time measurements, and accurate measurements of waveform jitter. Also, it is possible to pick off and display any desired line of a television scan or to check pulse-time modulation.

b. Sweep Range Indicators

The NDT TIME/DIV switch is provided with an indicator window mounted on a plastic skirt; the DA TIME/DIV switch is mounted on top of this skirt and is identified as the Delayed Sweep knob. Turning the knob of the latter will also permit control of the Delayed Sweep time duration. A push-pull clutch permits the outer knob to engage the skirted knob to adjust both sweep ranges simultaneously, or the Delayed Sweep range knob may be declutched and rotated independently to sweep rates faster than the NDT sweep rate.

c. Normal Sweep Display

When the DISPLAY LOGIC switch is set to NORMAL, only the NDT Time Base is displayed. Triggering is derived from the displayed signal internally or line. External signals may be applied to the lower EXT TRIG connector. Refer to Figure 2-2.

d. Triggered Strobe Display

When the DISPLAY LOGIC switch is set to Triggered STROBE, and the Delayed TIME/DIV switch is set for a higher sweep rate than the NDT TIME/DIV switch, a portion of the sweep may be brightened. (See Figures 2-3a and 2-4a.) The start of the brightened portion (Strobe) indicates the start of the Delayed Sweep and the length of the strobe indicates the Delayed Sweep duration. The start of the strobe may be positioned left or right with the DELAY VERNIER control. The length of the strobe may be adjusted with the Delayed TIME/DIV control. Note that the start of the strobe is not affected by the setting of the latter control. Using these two controls, it is possible to include any portion of the display waveform in the brightened or strobed area.

The amount of delay occurring from the application of the triggering waveform until the Delayed Sweep is permitted to run, is determined by the setting of the NDT TIME/DIV switch and the DELAY VERNIER control. The Delayed Sweep will occur immediately at the end of the preset delay period. This mode from now on will be referred to as the Delayed-Triggered sweep mode. It is the mode of operation that permits the operator to select continuously variable delay times for making accurate time and waveform jitter measurements.

The Delayed Sweep automatically shuts off when the Normal Sweep is terminated. This prevents brightening of the sweep retrace in either of the STROBE positions.

e. Delayed Triggered Display

When the DISPLAY LOGIC switch is set to Triggered DELAYED, the brightened section of the display in the STROBE position is now expanded to full scale. See Figures 2-3b and 2-4b.

The amount of magnification is the ratio of the NDT sweep rate to the Delayed Sweep rate. The magnification ratio may be expressed:

$$\text{Magnification ratio} = \frac{\text{Normal Sweep Rate (Time/Div)}}{\text{Delayed Sweep Rate (Time/Div)}}$$

For example, if the NDT TIME/DIV switch is set to 1 mSEC, and the Delayed TIME/DIV switch is set to 1 μSEC, the brightened portion of the sweep is magnified horizontally 1000 times when the DISPLAY LOGIC switch is set to the Triggered DELAYED position.

Automatic provision is made for shutoff of the Normal Sweep when the Delayed Sweep is terminated. This permits maximum duty-cycle performance in the DELAYED MODE.

f. Delayed-Armed Operation

If the display is set for Delayed-Armed operation, the delayed sweep does not start at the end of the indicated delayed period until a triggering pulse is applied to the DA trigger circuit. This triggering pulse

may be either the input waveform to the oscilloscope or an externally-derived triggering signal. The triggering Source, Coupling, Slope, and Level may be selected in the same manner as for the conventional STROBE and DELAYED triggered operation. In the Delayed-Armed mode of operation, the Delayed Sweep does not start precisely at the delay time indicated by the DELAY VERNIER and NDT TIME/DIV control setting, but instead is initiated by the next suitable triggering following the indicated delay interval. This mode from now on will be referred to as the Delayed-Armed mode of sweep operation. See Figures 2-4a and 2-4b.

The armed delayed time display does not appear to be continuously variable. The Armed mode should be used whenever the signal to be displayed has accumulative jitter between the start of the normal sweep and the delayed magnified section.

g. Automatic NDT Sweep

Auto triggering provides a visible base line on all sweep ranges when there is no signal input. The sweep free runs until a trigger signal with frequencies between 10 cycles and approximately 10 megacycles is applied. The application of the trigger signal immediately switches the sweep to the triggered mode thus providing stable sync. When the triggering signal is removed, the sweep reverts to the free-running mode after a delay of about 1 second.

The automatic NDT sweep mode is very useful when doing equipment testing since a reference trace will always be visible with or without a signal applied to the oscilloscope. To obtain automatic NDT sweep operation, set the Sweep Mode toggle switch to AUTO position.

h. HF Recurrent Sweep

Stable synchronization of very high frequency signals can be best accomplished when the NDT sweep is operating in the recurrent mode. Recurrent operation is selected by setting the Sweep Mode toggle switch in the HF RECUR position. Use of this switch improves the count down and lock-in of signals having repetition rates of 5 Mc or greater. It provides stable synchronization of signals of 1 cm deflection to beyond 50 Mc.

i. Single-Sweep Operation

Single sweep operation infers that the time base sweeps once across the face of the CRT then stops. This is initiated by placing the SWP-MODE controls to SGL and NORM. At this time the sweep generator is off and cannot be triggered. Setting the SWP-MODE to REARM arms the sweep, thus a trigger from either INT, EXT, or LINE will cause one trace to occur.

2-8. SWEEP EXPANDER

When the POSITION control knob is pulled out, the sweep may be expanded horizontally by a factor of 10 about the screen center. Thus, to achieve an X10 expansion of a desired segment of the trace, set that segment of interest to the screen center with the POSITION control and pull out this control. Any portion of the expanded display may be observed by adjusting the POSITION control.

When the instrument is set up for X10 expansion of the sweep, the sweep rate indicated by the setting of the TIME/DIV control must be divided by 10 to obtain the actual time required for the spot to move one division. For example, if the TIME/DIV control is set to 10 mSEC, the actual time per division is 10 milliseconds, divided by 10, or 1 millisecond per division.

2-9. SWEEP CALIBRATION ADJUSTMENT

Whenever the Time Base Plug-in is removed from the Main Frame and inserted in another, the front-panel screwdriver SWP CAL control must be reset. This procedure is necessary to compensate for difference in deflection plate sensitivities. In addition, if the Time Base unit is switched from the X cavity to the Y cavity of the same Main Frame, readjustment will be necessary since the difference in average deflection plate voltages between modules affects the over-all deflection sensitivity of the cathode-ray tube. To properly normalize the gain between channels or between the plug-in unit and the Main Frame, proceed as follows:

1. Set up the instrument for normal display of the CAL signal. Allow a warmup time of 15 minutes. (See Figure 2-2.)
2. Set TIME/DIV switch to 10 mSEC.
3. Adjust SWP CAL front-panel screwdriver control for precisely 6 cycles of the calibrator display (60-cycle line) in 10 divisions.

NOTE: For 50-cycle line, adjust SWP CAL control for 5 cycles of the calibrator display. For 400-cycle line, use 0.5 msec/div sweep and adjust SWP CAL control for 2 cycles of the calibrator display.

2-10. X-Y DISPLAYS

CAUTION

KEEP INTENSITY LOW

Screen damage can result from too intense a beam resting at one point on the screen.

When desiring to view one voltage plotted against another (not the internal time base) apply the Y signal to INPUT A connector on the Y Plug-in and the X signal to X AMP (green) BNC connector on the Delaying Sweep module. X-Y displays may be used to show sweep signal generator plots, Lissajous phase measurements, curve trace information and other similar signal relationship.

Set the DISPLAY LOGIC switch to X AMP, the DA Trigger SOURCE switch to EXT, and the DA SLOPE switch to +. Adjust the VOLTS/DIV and X AMP ATTEN controls to obtain an appropriate display on the screen.

2-11. GATE OUTPUT

A positive gate coincident with the sweep output is available on a front-panel BNC connector labeled + GATE. The gate amplitude is 2.5 volts nominal into an impedance of 500 ohms and load impedance should be greater than 100K ohms shunted by less than 15 pf. This positive pulse may be used to trigger other devices in order to achieve sufficient delay to view the output of such devices completely displayed on the oscilloscope.

Use of the gate output in conjunction with triggered pulse generators will permit the instrument to display the leading edge of the pulse waveform even though no signal delay is incorporated in the Y Amplifier.

The period of the positive gate may of course, be measured extremely accurately with an electronic counter. Since the period of the gate output is a direct measure of total sweep time, it is possible to use this oscilloscope in conjunction with a counter to digitize the time duration of input signals. Use of the TIME/DIV and the VARIABLE controls will permit the operator to display the waveform to be measured over the entire sweep. Timing accuracies of 1 part in 10^7 are thus readily obtainable.

2-12. SAWTOOTH OUTPUT

A front-panel connector labeled SAW provides a positive-going saw of approximately 25 volts amplitude. The saw output is referenced within minus 3 volts of ground and is time coincident with the NDT sweep.

The sawtooth voltage may be used for initiating delayed activities, controlling an X-Y plotter, or acting as a time base for associated analog equipment. The sawtooth output should not be loaded by an impedance to ground of less than 100K ohms shunted by no more than 15 pf. Voltage take-off through an attenuator probe is recommended.

2-13. TIME MEASUREMENTS

a. How to Make Elapsed Time Measurements Using the CRT Scale

Any horizontal distance on the screen of the oscilloscope can be used to represent a precise interval of time when the time-base circuits are set up for calibrated sweep (TIME/DIV Vernier control set to CAL). Use of this feature permits you to accurately measure the elapsed time between the desired point of interest on the display. To measure the time interval, proceed as follows:

1. Using the calibrated scale, measure the horizontal distance in divisions between that portion of the display whose time interval you wish to find.
2. Multiply the horizontal dimension obtained in Step 1 by the TIME/DIV control setting to obtain the time interval. See Figure 2-5.

b. How to Find Repetition Rate of Frequency Using the CRT Scale

The repetition rate or frequency for periodic signals can be expressed as the number of cycles or pulses per unit of time (TIME/DIV Vernier control set to CAL). To use the oscilloscope for measuring the repetition rate or frequency of periodic signals, proceed as follows:

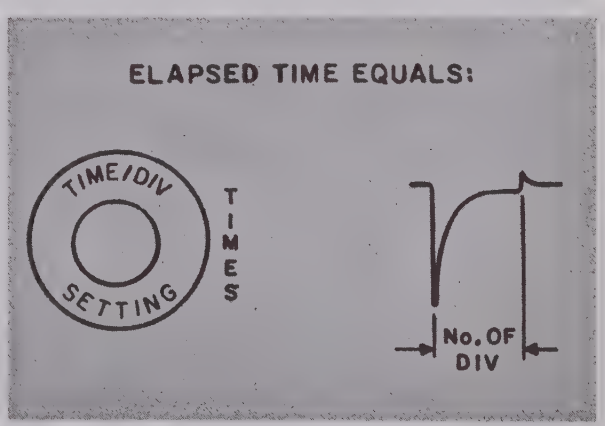


Figure 2-5. Elapsed Time Measurement

1. Using the calibrated scale, measure the horizontal distance in divisions occupied by one cycle of the display under observation.
2. Multiply the horizontal dimension obtained in Step 1 by the TIME/DIV control setting.
3. Take the reciprocal of the product obtained in Step 2 (that is, divide it into one). The resulting quotient is the desired frequency or repetition rate in cycles per second. See Figure 2-6.

$$\text{Cycles/second} = \frac{1}{\text{Time (seconds)}}$$

2-14. PHASE-SHIFT MEASUREMENTS

To measure the phase difference between two sine waves, proceed as follows:

1. Set up the Delaying Sweep Time Base for externally triggered normal sweep operation.
2. Apply one of the sine waves to Channel A Input and the other to Channel B Input of the Type 76-02A Amplifier.
3. Set MODE switch to ALT.
4. Adjust the TIME/DIV switch for a couple of cycles of the display on the screen.
5. Position the display so that one of the positive slopes crosses the horizontal center line at the left hand side of the scale.
6. Measure the horizontal distance occupied by one cycle of the waveform. Label this distance A.
7. Measure the horizontal shift of the Channel B display. Label this distance B.
8. Divide the distance measured in step 6 by the distance measured in step 7 and multiply the quotient by 360°. The resulting product is the phase difference between the two sine waves. See Figure 2-7.

$$\text{Phase-shift difference} = \phi = \frac{B}{A}\ 360°$$

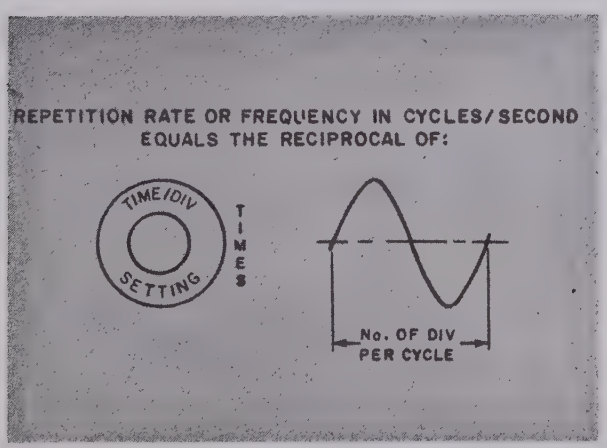


Figure 2-6. Finding the Frequency

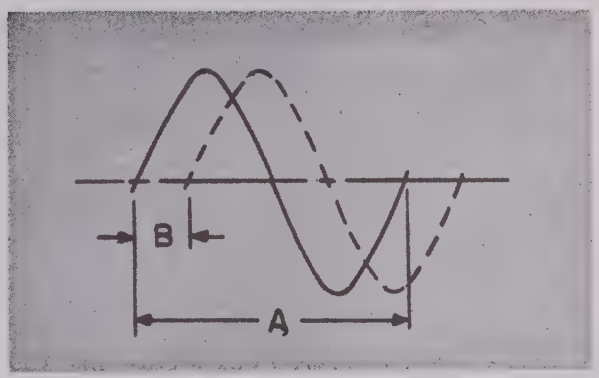
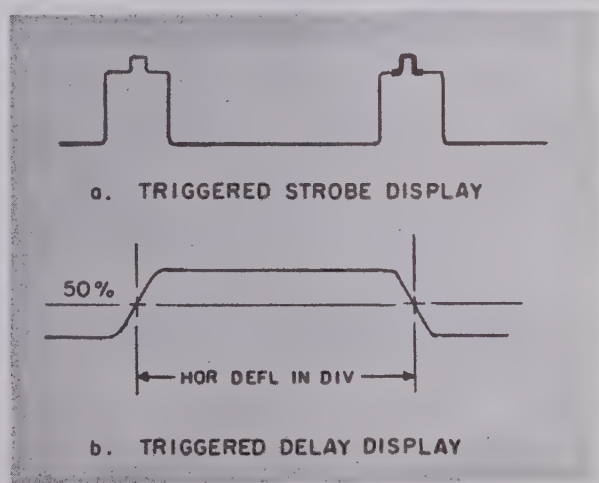


Figure 2-7. Phase-Shift Measurements

2-15. PULSE WIDTH MEASUREMENTS USING THE CRT SCALE

Assume you have a Normal sweep display similar to Figure 2-8 and you wish to measure the width of the pulse appearing on the pedestal pulse. To make this measurement, proceed as follows:

1. Make sure the TIME/DIV Vernier control is set fully clockwise to CAL. (Click is heard.)
2. Set the DISPLAY LOGIC switch to TRIGGERED STROBE.
3. Pull out the DA TIME/DIV knob to disengage it and rotate it and the DELAY VERNIER control until the desired pulse is intensified (Figure 2-8a).
4. Set the DISPLAY LOGIC switch to TRIGGERED DELAY and measure the horizontal distance in divisions from the 50% point on the rise of the pulse to the 50% point on the fall of the pulse. Multiply this distance by the DA TIME/DIV control setting (Figure 2-8b).



Pulse width =
(DA TIME/DIV setting) (Hor Defl in Div)

Figure 2-8. Pulse Width Measurements

2-16. PULSE WIDTH MEASUREMENTS USING THE DELAY VERNIER CONTROL

The following technique avoids human error (parallax interpolation of graticule lines) and should be used with more than routine accuracy if needed:

1. Make sure the TIME/DIV Vernier control is set fully clockwise to CAL (click is heard).
2. Set DISPLAY LOGIC switch to TRIGGERED STROBE and adjust the controls for several cycles of the signal.
3. Pull out the DA TIME/DIV knob and turn it to the right until the intensified area is a small bright dot.
4. To measure pulse width, turn the DELAY VERNIER control until the bright spot is at the 50% part of the leading edge of the desired pulse (Figure 2-9a). Record the dial reading.
5. Turn the DELAY VERNIER control to move the bright dot to the 50% point on the trailing edge of the same pulse (Figure 2-9b). Record the dial reading.
6. Subtract the reading of step 4 from that of step 5. Then multiply the difference by the setting of the NDT TIME/DIV switch. The product is the pulse width.

2-17. PULSE JITTER MEASUREMENTS

Pulse jitter may be defined as small incremental variations in pulse spacing in a pulse train. For example, assume a normal pulse train is displayed on the screen and it is desired to check a small pulse in the train for jitter; to check, proceed as follows:

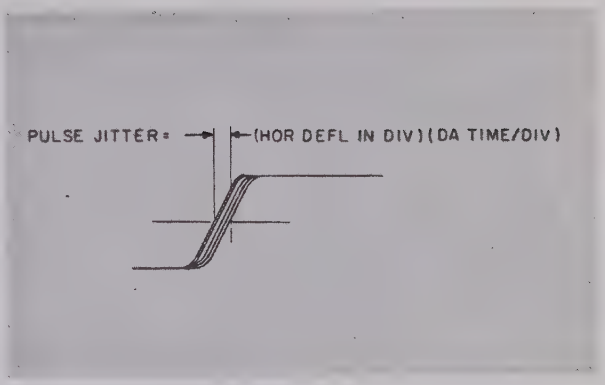
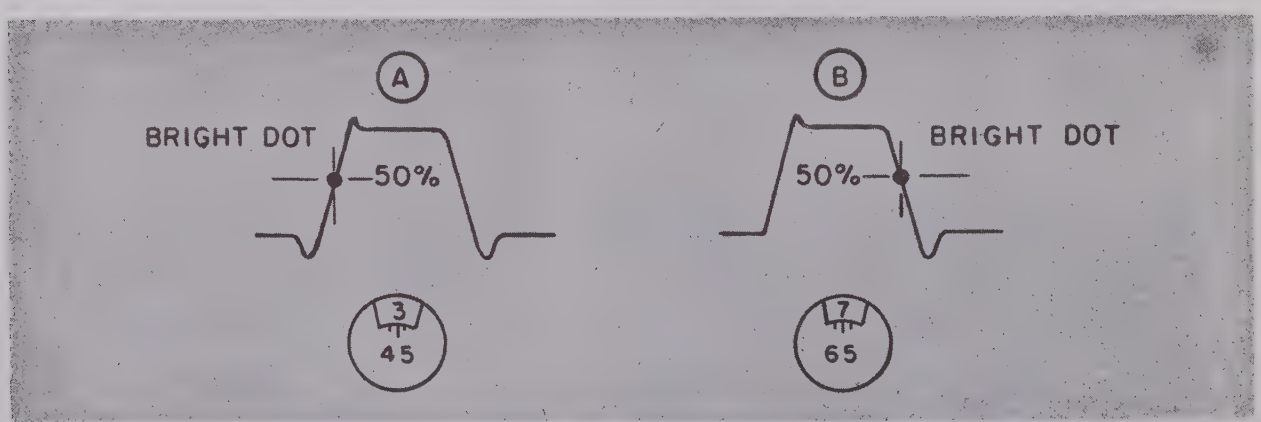


Figure 2-10. Pulse Jitter Measurement

1. Set up the instrument for external triggering.
2. Set the DISPLAY LOGIC switch to TRIGGERED STROBE.
3. Pull out the DA TIME/DIV knob and turn it to the right until the intensified zone (strobe) of the display is about the same width as the pulse to be checked.
4. Adjust the DELAY VERNIER dial to move the strobed sector over the pulse.
5. Set the DISPLAY LOGIC switch to DELAYED TRIGGER and adjust the DELAY VERNIER control to position the strobed pulse to screen center.
6. The leading edge of the strobed pulse will then show jitter if present. The amount of jitter can be measured in time by multiplying the horizontal distance in divisions of the jitter area by the setting of the DA TIME/DIV knob. See Figure 2-10.



a = 1st DELAY VERNIER Reading

b = 2nd DELAY VERNIER Reading

Δt = b-a = 7.65-3.45 = 4.20

Given: Sweep Rate = 2 mSEC

Pulse Width = (Δt) (NDT TIME/DIV setting)
= (4.20) (2 mSEC) = 8.4 mSEC

Figure 2-9. Pulse Width Measurements Using Delay Vernier Dial

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION (Figures 3-1 to 3-12)

To simplify circuit description, functional block and waveform timing diagrams at various DISPLAY LOGIC switch settings are provided as follows:

Figure 3-1a. NDT Trigger Circuit Functional Block Diagram
Figure 3-1b. DA Trigger Circuit, Functional Block Diagram
Figure 3-2. Normal Sweep Mode, Functional Block Diagram
Figure 3-3. Timing Diagram for Normal Sweep Display
Figure 3-4. Triggered Strobe Mode, Functional Block Diagram
Figure 3-5. Simplified Timing Diagram for Triggered Strobe Display
Figure 3-6. Delayed Triggered Mode, Functional Block Diagram
Figure 3-7. Simplified Timing Diagram for Delayed-Triggered Display
Figure 3-8. Armed Strobe Mode, Functional Block Diagram
Figure 3-9. Simplified Timing Diagram for Delayed-Armed Strobe Display
Figure 3-10. Delayed-Armed Mode, Functional Block Diagram
Figure 3-11. Simplified Timing Diagram for Delayed-Armed Display
Figure 3-12. Horizontal Deflection Amplifier, Functional Block Diagram

The timing diagrams show waveforms at critical points in the circuit and in proper relative time relationship. In addition, a capsule description of each waveform is provided.

The circuit description will be keyed to the aforementioned illustrations. Emphasis is placed on the interrelation of circuits rather than on detail of operation. It is also recommended that the schematics at the rear of the manual be referred to in following the circuit description.

3-2. TRIGGER CIRCUIT DESCRIPTION (Figures 3-1a and 3-1b)

a. Normal and Delaying Triggering

Since the input of the Normal and Delaying triggering circuit (NDT) is similar to that of Delayed Armed (DA) trigger circuit, only the NDT circuit will be discussed in detail. Refer to paragraph 3-8 for a description of the X Input circuit.

The input to the trigger amplifier V8201 and V8202, may be selected from one of three sources via the Trigger SOURCE switch as follows:

(1) In EXT or EXT/10 position, the signal is obtained from an external source through the EXT TRIG front-panel connector;

(2) in INT position, the signal is derived from the Y Plug-in unit; and

(3) in LINE position, the signal is tapped from one side of the 6.3 VAC heater circuit.

A choice of AC, ACF, or DC coupling is provided by the Trigger COUPLING switch. In the AC position, the trigger signal is applied to a high-pass filter consisting of C8203, C8205, and R8207, providing a low-frequency cutoff of 80 cycles. The low-frequency cutoff is raised to 10 Kc in the ACF position and the high-pass filter now has R8204 shunting R8207. In the DC position, the high-pass filters are disconnected and the triggering signal is applied directly to the trigger amplifier. The RC network, R8206 and C8202, in series with the grid of V8201 or V8202, serves to protect the input circuit from damage due to excessive input voltage. Shunt capacitor C8202 across R8206 preserves the high-frequency signal component.

The negative pulse at the output of the trigger amplifier occurs only when there is a positive-going signal at the input. However, it is desirable to start the sweep during either a positive-going or negative-going portion of the excitation signal. To accomplish this, the Trigger SLOPE switch is used to select the desired polarity of the triggering signal.

For positive-going signals, connection is made to the grid of V8201, and for negative-going signals, connection is made to the grid of V8202. In each case, the opposite grid is connected to a dc bias source, adjustable by means of the Trig LEVEL control R8222. This control is used to select the level of the triggering point for all settings of the Trigger SLOPE switch.

The output from V8201 or V8202 is applied to a trigger shaper Q8202 which drives the trigger coupling transformer T8201. The resulting negative trigger is applied to series coupling diode CR8203 to the base of the delaying sweep gate multivibrator.

The TRIG SENS adjustment R8229, sets the tunnel diode trigger at its optimum sensitivity. The TRIG BAL adjustment R8234, sets the level of V8201 and V8202 through tunnel diode CR8201, so that no readjustment of the Trig LEVEL control is required when the Trigger SLOPE switch is set from plus to

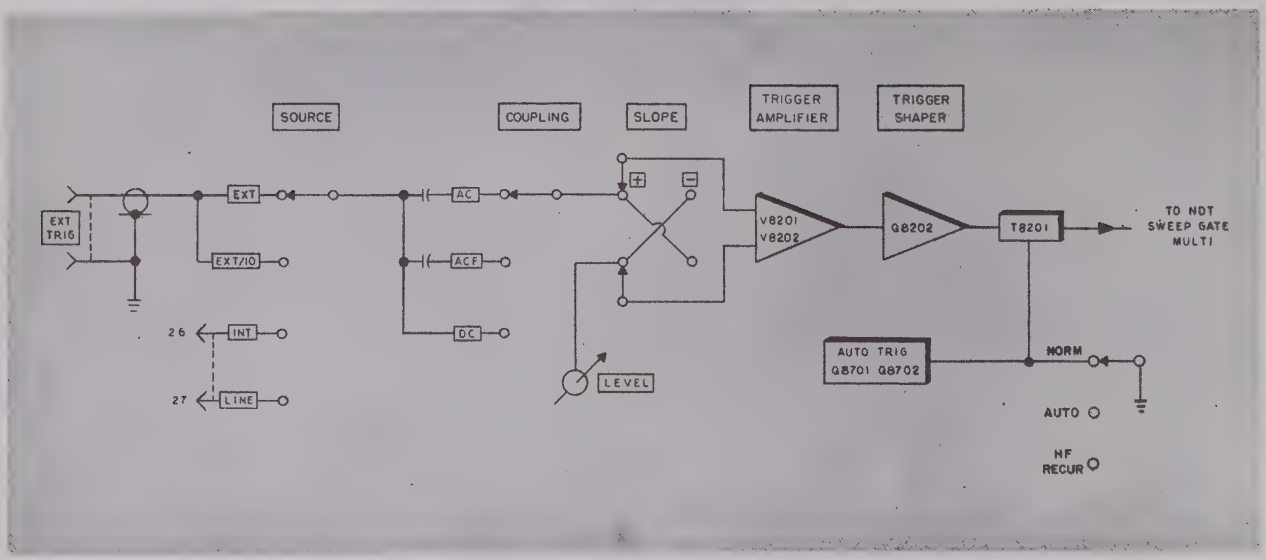


Figure 3-1a. NDT Trigger Circuit, Functional Block Diagram

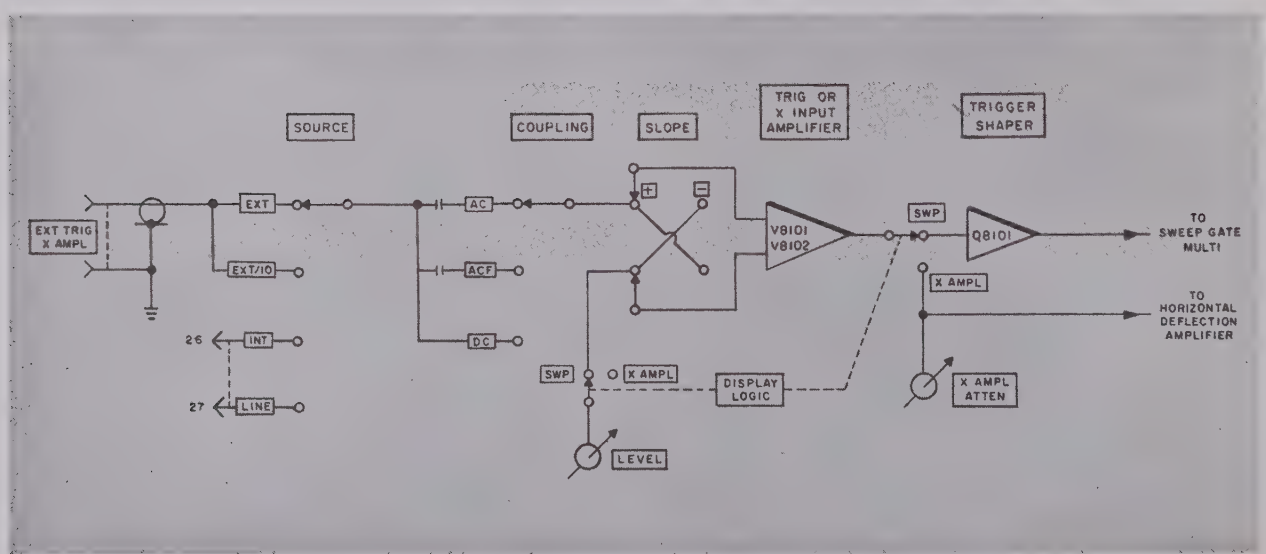


Figure 3-1b. DA Trigger & X Input Circuits, Functional Block Diagram

minus slopes or vice versa. This adjustment is made when the Trig LEVEL control is set to Zero.

b. Automatic Triggering

When the Sweep Mode toggle switch is set to AUTO, the trigger circuit is ungrounded and becomes activated. Application of a trigger signal from 10 cps to 10 Mc switches the sweep immediately to the triggered mode. This technique insures stable synchronization of the desired input signal. The auto trigger multivibrator reverts to its natural mode in about 1 second after the discontinuance of the trigger excitation signal. Consequently, a horizontal reference trace will appear on the screen even in the absence of an input signal.

3-3. CIRCUIT DESCRIPTION OF NORMAL SWEEP (Figures 3-2 and 3-3)

a. Delaying Sweep Gate Multivibrator

The input triggering signal is applied to the base of transistor Q8206, through series-coupling diode CR8203. The dc coupled bistable multivibrator Q8206 and Q8207, initiates the formation of the sweep after receiving a negative trigger from the shaper circuit. Diode CR8203 and the lockout circuit hold off subsequent triggering signals until after the sweep and retrace are completed. In the quiescent state, Q8206 is conducting and Q8207 is at cutoff. Q8206 forms a positive gate while Q8207 forms a negative gate during the forward sweep interval.

CR8203 serves as a low capacitance coupling diode which couples the negative trigger from the shaper circuit to the sweep gate multivibrator which flips and initiates the sweep. CR8203 also serves as a high back-impedance diode to decouple the trigger shaper from the sweep gate multivibrator. After the bistable multivibrator has been triggered, the sweep runs up. When the saw reaches full screen deflection, turn-off diode CR8204 conducts and resets the multivibrator Q8206 and Q8207, which then clamps the saw. The SWP LENGTH potentiometer R8263 is adjusted for full screen sweep length display.

b. Saw Generation

The saw generator is of the Miller "run-up" type. The negative output developed at the collector of Q8207 is applied to the anodes of the disconnect diodes CR8205, CR8209, CR8211 and CR8216. The anode voltages of these diodes no longer conduct. This action unlocks the integrator clamp and permits the selected sweep capacitor to charge linearly through the associated resistance network.

The grid of the Miller integrator moves negatively when the clamp is unlocked. The plate voltage of V8203 rises positively carrying the saw cathode-follower (V8204) grid, cathode and timing capacitor in the same direction. A flow of current is required into the charging capacitor if the voltage across this capacitor is to change. The charging current must flow through the charging resistor. The time required to change the voltage across the charging capacitor determines the sweep time.

The positive voltage swing on the opposite side of the timing capacitor tends to prevent the grid side from swinging negatively. It also increases the voltage to which the timing capacitor is trying to charge. The net result is to *straighten out* the charging curve (sweep voltage) by maintaining a constant current flow in the capacitor.

Since the grid of V8203 remains at a constant potential within a small fraction of a volt, the current through the charging resistor remains constant and the sweep timing capacitor thus charges at a constant rate. The resulting linear sawtooth waveform is applied to the horizontal deflection system.

c. Sweep Length

The sweep length, or the total duration of the sweep for any given sweep rate is determined by the setting of the Sweep LENGTH adjustment R8263. A portion of the positive sawtooth voltage is fed back to the turn-off emitter follower Q8208, and the saw turn-off diode CR8204.

If the Sweep LENGTH potentiometer is properly set, diode CR8204 will conduct when the positive-going excursion of the sawtooth has travelled 10.5 to 11 divisions on the screen. This positive peak signal will then be conducted through diode CR8204 to the base of Q8206. Upon receiving this positive pulse, the sweep gate multivibrator will revert rapidly to its original state with Q8206 conducting, and Q8207 at cutoff. The positive step from the collector of Q8206 returns the disconnect diodes CR8216, CR8209, CR8211 and CR8205 to their conducting state, thus discharging the timing capacitors. The Miller circuit now returns to its quiescent level and is ready for the next sweep cycle after the lockout time interval is completed.

d. Lockout Circuit

The lockout circuit prevents the sweep gate multivibrator from being triggered until the sweep retrace interval has reverted the saw to its quiescent base level. The sweep does not retrace in zero time since the clamping of the Miller integrator timing capacitor is accomplished by a diode switch circuit having a small impedance. The timing circuit discharge (saw retrace) takes longer than the flipping of the sweep gate multivibrator. Consequently, the trigger excitation pulses must be held off to prevent the formation of a new saw during the retrace interval. The sawtooth waveform must be permitted to retrace completely to its quiescent base which re-establishes the

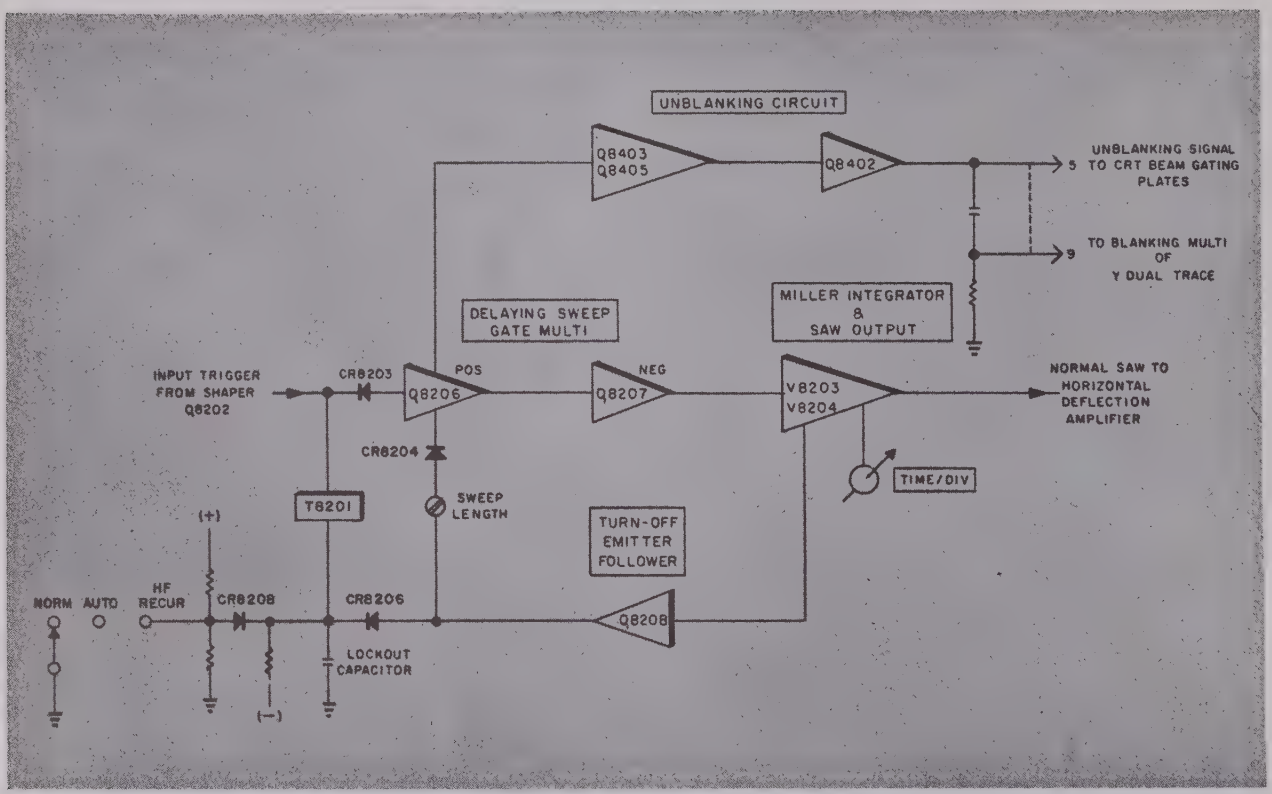


Figure 3-2. Normal Sweep Mode, Functional Block Diagram

beam at the left-hand side of the CRT screen. This is accomplished by holding the cathode of the series-triggering diode CR8203 at a suitable positive voltage for a given period after the completion of the sweep.

During the forward sweep interval, a portion of the positive sweep voltage is fed back to the base of the turn-off emitter follower Q8208, which charges the lockout capacitor through coupling diode CR8206. When the saw reaches its predetermined full screen length, the sweep gate multivibrator flips and clamps the Miller integrator which then causes the sweep to retrace. During the return-trace interval, diode CR8206 is cut off and the lockout capacitor is discharged through R8261. The sweep gate multivibrator will not retrigger until the preselected lockout timing capacitor is chosen to give lockout beyond the time that the sweep has returned to rest at its initial starting point.

The duration of the lockout interval is determined by the sweep-charging time constant and the Miller integrator clamp. Consequently, the TIME/DIV switch must also change the lockout circuit hold-off timing capacity. This technique prevents additional triggers from initiating the sweep gate multivibrator until the sweep retrace interval is completed and the saw reverts to its quiescent state at the left-hand side of the screen.

The trigger coupling diode CR8203 prevents triggers from disturbing the sweep gate multivibrator during all of the sweep-forward interval. The lockout circuitry prevents retriggering during the retrace interval.

e. Unblanking

The cathode-ray tube employed in this oscilloscope has two additional beam deflecting plates which cut off the electron beam independently of the control grid. Beam control pulses (trace brightening and retrace blanking pulses) can easily be dc coupled since these beam deflection plates are electrically close to ground. In conventional circuits these pulses must be coupled to the control grid which is operated at high potential. The extra beam deflection plates are controlled by the sweep gate multivibrator Q8206 and Q8207.

The positive pulse developed at the collector of Q8206 of the delaying sweep gate multivibrator is applied to the base of the unblanking cascode amplifier Q8405 and Q8403. This gate signal is coincident with the sweep forward time and is also available at a front-panel connector labeled + GATE. The resulting negative pulse developed at the collector of

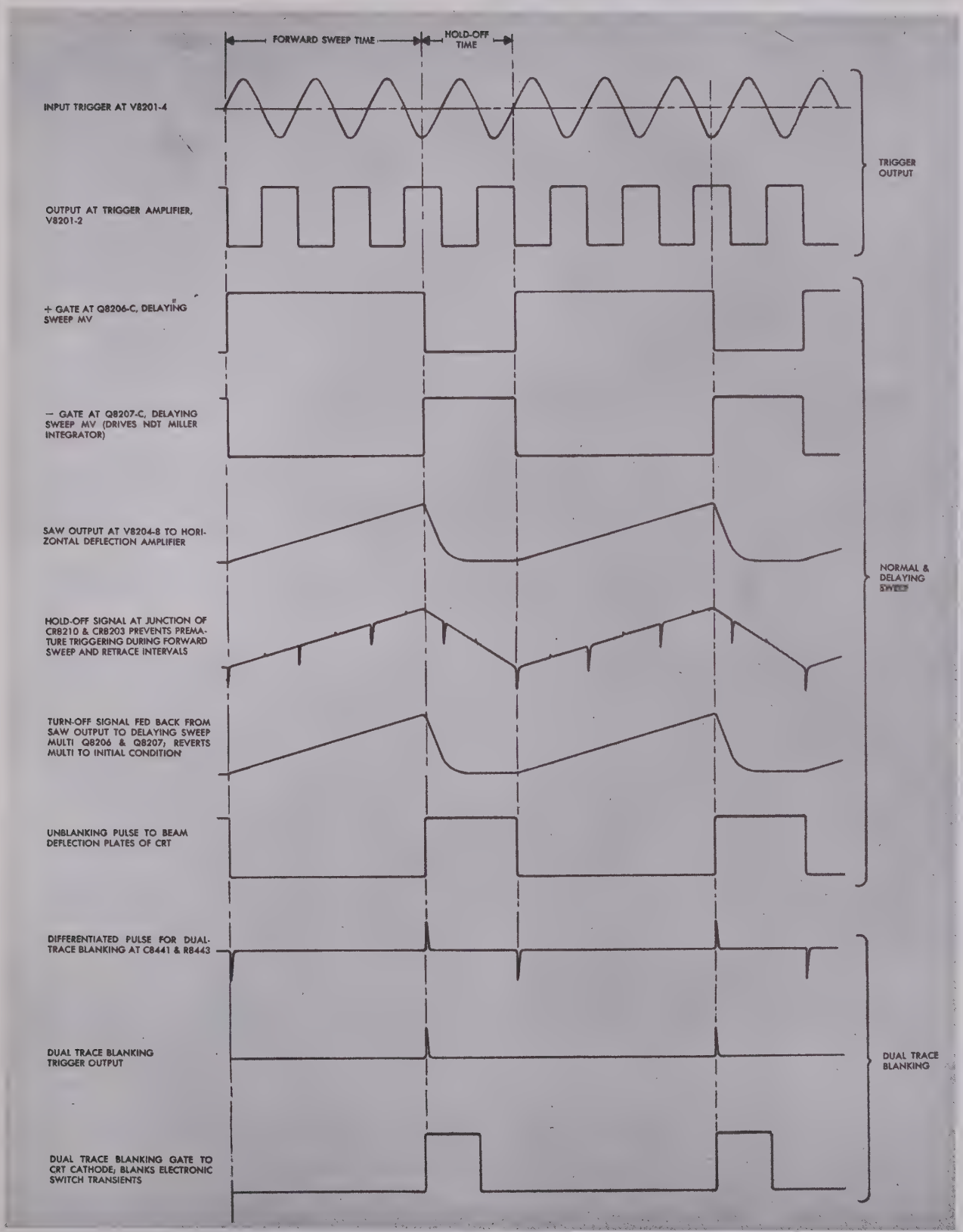

FORWARD SWEEP TIME
HOLD-OFF TIME
INPUT TRIGGER AT V8201-4
OUTPUT AT TRIGGER AMPLIFIER, V8201-2
TRIGGER OUTPUT
+ GATE AT Q8206-C, DELAYING SWEEP MV
— GATE AT Q8207-C, DELAYING SWEEP MV (DRIVES NDT MILLER INTEGRATOR)
SAW OUTPUT AT V8204-8 TO HORIZONTAL DEFLECTION AMPLIFIER
HOLD-OFF SIGNAL AT JUNCTION OF CR8210 & CR8203 PREVENTS PREMATURE TRIGGERING DURING FORWARD SWEEP AND RETRACE INTERVALS
TURN-OFF SIGNAL FED BACK FROM SAW OUTPUT TO DELAYING SWEEP MULTI Q8206 & Q8207; REVERTS MULTI TO INITIAL CONDITION
NORMAL & DELAYING SWEEP
UNBLANKING PULSE TO BEAM DEFLECTION PLATES OF CRT
DIFFERENTIATED PULSE FOR DUAL-TRACE BLANKING AT C8441 & R8443
DUAL TRACE BLANKING TRIGGER OUTPUT
DUAL TRACE BLANKING
DUAL TRACE BLANKING GATE TO CRT CATHODE; BLANKS ELECTRONIC SWITCH TRANSIENTS

Figure 3-3. Timing Diagram for Normal Sweep Display

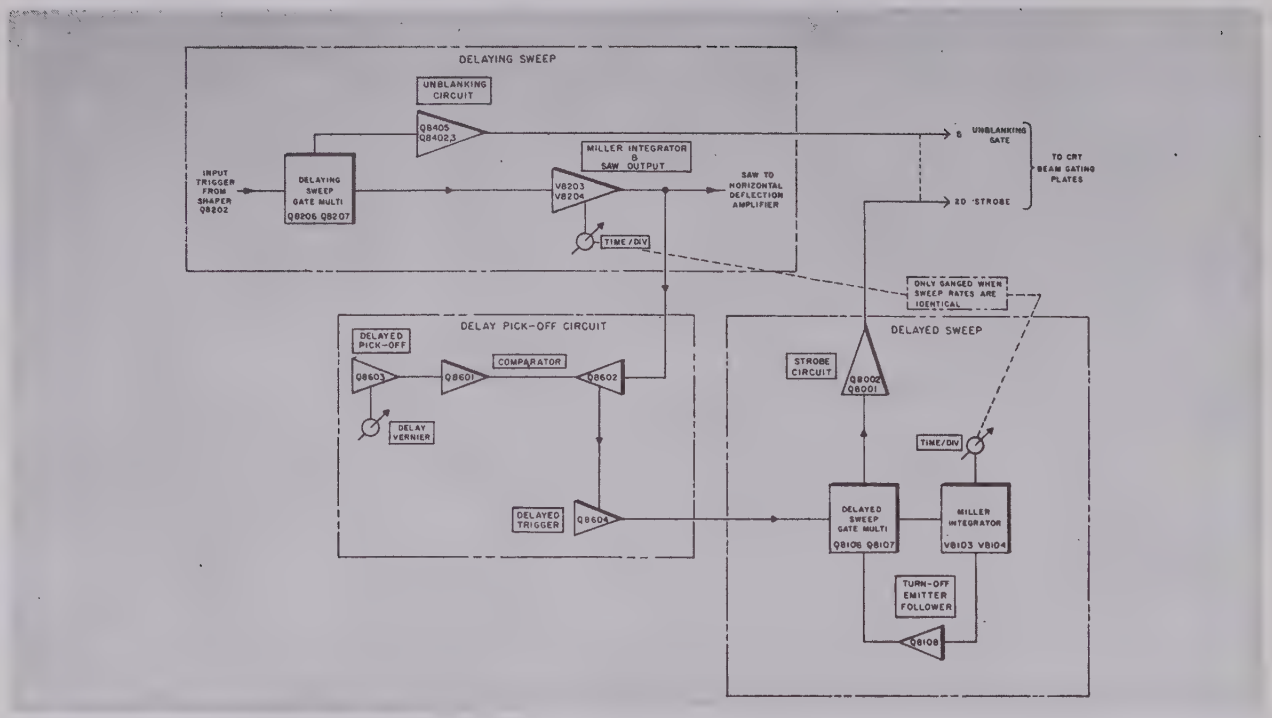


Figure 3-4. Triggered Strobe Mode, Functional Block Diagram

Q8403 is applied to the beam deflection plate of the cathode-ray tube through emitter follower Q8402. Therefore the display is visible only during the forward sweep interval and is blanked during the retrace and lockout interval.

Transistor Q8401, serves as an emitter follower voltage source for the collector of Q8402, and it also prevents the collector voltage of Q8403 from exceeding 125 volts.

A portion of the negative pulse from the unblanking emitter follower Q8402 is applied to a differentiating network C8441 and R8443. The output from this network provides the proper trigger to the blanking multivibrator of the Dual Trace Plug-in.

These Delaying Sweep Time Base Plug-in units may be used in the X or Y cavity of the Main Frame. Only the X cavity permits retrace beam blanking signals to be coupled to the cathode-ray tube. Therefore, sweep operation in the vertical direction will show the sweep retrace.

f. Single Sweep

When S825 (SWP-MODE) is set to SGL, the feed back loop described in Section 3-3 is opened up preventing retrace from occurring. After the completion of one trace, Q8206 is held in the off mode by having its base connected to ground through R8290. In this mode, C8242 charges to −50V. When S825 is momentarily set to the REARM mode, one end of C8242 is connected to ground. This forces the other end of C8242 to go to +50V and turn on Q8206. At this time the trigger multi, Q8206 and Q8207, is in the ARMED mode. Any trigger coming from T8201 will cause one sweep to occur and the process repeats. In addition Q8209 turns off which lights DS8202 indicating the ARMED mode.

Notice that when the sweep generator is functioning in the normal mode, CRT blanking occurs when retrace starts by utilizing the collector signal of Q8206. Since in the SINGLE mode, retrace occurs only when REARM is initiated, a circuit must be employed which blanks the CRT when the sweep reaches the right side of the CRT. This is accomplished with Q8210. When the ramp from Q8208 reaches approximately 33 volts, Q8210 is turned off and its collector rises to approximately ±125 volts. This signal is fed through CR8219 to the blanking plates in the CRT. When REARM is initiated and the sweep generator retraces, Q8210 turns on and its collector is clamped to +50V by CR8218. Normal blanking is now provided through Q8206.

3-4. CIRCUIT DESCRIPTION OF TRIGGERED-STROBE MODE

(Figures 3-4 and 3-5)

When the DISPLAY LOGIC switch is set to Triggered STROBE, the delay pick-off, the delayed sweep, and strobe circuits are activated

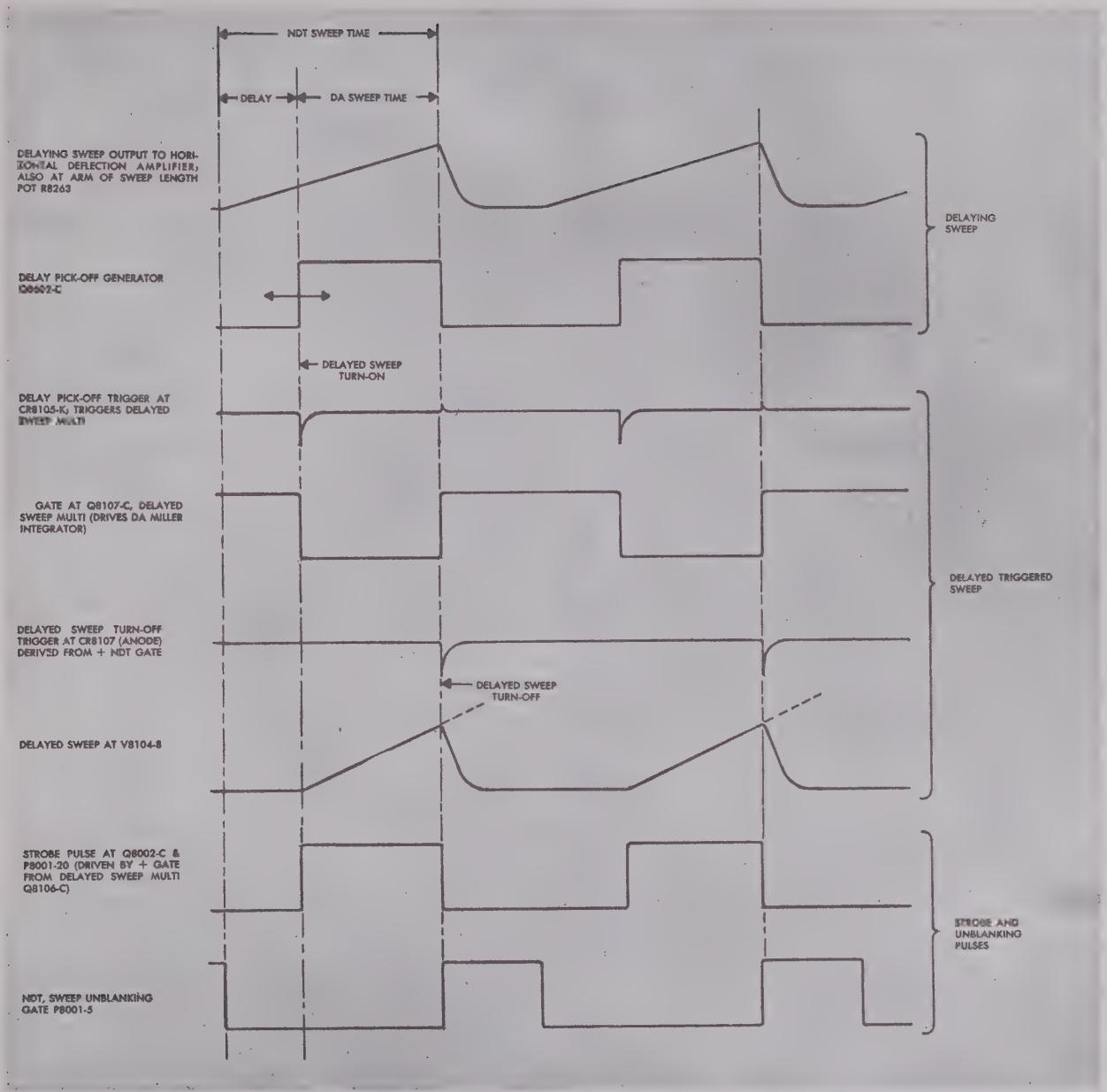

NDT SWEEP TIME
DELAY
DA SWEEP TIME
DELAYING SWEEP OUTPUT TO HORIZONTAL DEFLECTION AMPLIFIER, ALSO AT ARM OF SWEEP LENGTH POT R8263
DELAYING SWEEP
DELAY PICK-OFF GENERATOR Q8602-C
DELAYED SWEEP TURN-ON
DELAY PICK-OFF TRIGGER AT CR8105-K; TRIGGERS DELAYED SWEEP MULTI
GATE AT Q8107-C, DELAYED SWEEP MULTI (DRIVES DA MILLER INTEGRATOR)
DELAYED TRIGGERED SWEEP
DELAYED SWEEP TURN-OFF TRIGGER AT CR8107 (ANODE) DERIVED FROM + NDT GATE
DELAYED SWEEP TURN-OFF
DELAYED SWEEP AT V8104-8
STROBE PULSE AT Q8002-C & P8001-20 (DRIVEN BY + GATE FROM DELAYED SWEEP MULTI Q8106-C)
STROBE AND UNBLANKING PULSES
NDT, SWEEP UNBLANKING GATE P8001-5

Figure 3-5. -Simplified Timing Diagram for Triggered-Strobe Display

In the "triggered" mode, the delaying sweep receives the external trigger signal while the delayed sweep receives its trigger signal later from the delaying sweep. The triggering signal for the delayed sweep in this mode is derived from the delaying sweep at the exact instant this sweep reaches a level determined by the adjustment of the delay pick-off circuit. This mode from now on will be referred to as the delayed-triggered mode.

The Normal and Delaying Sweep circuit functions as previously described. Major differences between the triggered strobe and the Normal mode circuits may be seen by comparison of the block diagram.

Referring to Figure 3-4, the saw from the Delaying Sweep circuit is applied to the horizontal deflection amplifier and to the input of the delay pick-off comparator circuit Q8601 and Q8602.

This circuit is a differential amplifier which compares the voltage level of the input delaying sweep against a fixed voltage obtained from the DELAY VERNIER control. When the voltage level of the delaying sawtooth waveform reaches a certain level, as determined by the setting of the DELAY VERNIER control, the output of the comparator circuit is applied to a delayed trigger amplifier Q8604, which drives coupling transformer T8601. The negative pulse from the secondary of this transformer is through series-coupling diode CR8105, to trigger the delayed sweep gate multivibrator Q8106 and Q8107.

The positive gate developed at the collector of Q8106 is coincident with the *delayed* TIME/DIV

control setting and is applied to the strobe circuit Q8001 and Q8002. The positive strobe signal is applied to one of the beam-gating electrodes of the CRT. The delaying sweep unblanking gate is applied to the other beam-gating electrode.

The cathode-ray beam is kept turned off when a sweep is not moving the beam across the screen. When a sweep is in progress, the beam is turned on by an unblanking signal that lasts as long as the sweep and then turns the beam back off after the sweep is completed. When both the delaying and delayed sweeps are running, each produces its own unblanking signal. The delayed sweep unblanking pulse (strobe) makes a brighter trace than the delaying sweep pulse.

The difference in brightness for the two pulses is useful for finding out where to set the delay controls to display the part of the signal you wish to examine. Detailed instruction on setting up the strobe is found in Section 2, Operation.

The delaying sweep is automatically turned off when the delayed sweep has terminated. This action is developed as follows: the positive gate produced at the collector of the delayed sweep multivibrator Q8106, is applied to a differentiating network consisting of R8247 and C8216. Series-coupling diode CR8202, is biased to permit only the trailing edge of the delayed sweep gate to trigger the delaying sweep multivibrator and subsequently terminating the NDT sweep. This prevents brightening of the sweep retrace in the STROBE position.

3-5. CIRCUIT DESCRIPTION OF DELAYED-TRIGGERED MODE

(Figures 3-6 and 3-7)

When the DISPLAY LOGIC switch is set to Triggered DELAYED, the delayed sweep and not the delaying sweep is applied to the horizontal deflection amplifier. The brightened sector of the display in the STROBE position will now be expanded to full screen in the DELAYED position.

The delayed-triggered sweep circuit is similar in operation to the triggered-strobe mode described earlier, except that the strobe circuit is now activated.

Automatic provision is made for shut-off of the delaying sweep when the delayed sweep terminates. This technique permits maximum duty cycle performance in the Delayed Mode.

3-6. CIRCUIT DESCRIPTION OF ARMED-STROBE MODE

(Figures 3-8 and 3-9)

When the DISPLAY LOGIC switch is set to Armed STROBE, the delay pick-off circuit, the arming multivibrator, the delayed sweep, and strobe circuits are activated.

In the "armed" mode, the delayed sweep is triggered by a selected external triggering signal. All triggering signals are blocked by the armed lockout diode until a signal from the delay pick-off circuit triggers the arming multivibrator. This action unlocks the diode and opens the trigger circuit to the delayed sweep, making it possible for the next appropriate triggering signal to initiate the delayed sweep. In this mode of operation, the delayed sweep does not start precisely at the delay time indicated by the DELAY VERNIER and NDT TIME/DIV control settings, but instead is initiated by the next suitable triggering following the indicated delay interval. This mode from now on will be referred to as the Delayed-Armed mode of sweep operation.

The armed lockout diode CR8102, is now forward-biased by the voltage applied to it from the collector of Q8103, thus opening the triggering circuit to the delayed sweep gate generator Q8106 and Q8107.

The SWP READY lamp on the front panel goes on when the delay time has elapsed and indicates that the delayed sweep circuit is ready to be triggered. When the delayed sweep is triggered, the SWP READY lamp then goes out. If the delayed-armed sweep is triggered immediately at the completion of the delay time, the SWP READY lamp may not appear to go on.

The next suitable trigger from the DA trigger is applied to the delayed sweep multivibrator which immediately changes states (it flips). Q8106 forms a positive gate while Q8107 forms a negative gate during the "delayed" sweep forward interval.

In the quiescent state of the armed multivibrator, Q8103 is at cutoff and Q8104 is conducting. The armed lockout diode CR8102 is back-biased by the voltage applied to it from the collector of Q8103. This action locks out incoming triggering signals to the delayed sweep gate multivibrator, thereby inactivating the delayed sweep.

The arming signal from the delayed pick-off circuit is coupled from transformer T8601, through diode CR8104, to the base of transistor Q8104. The bistable armed multivibrator changes states: Q8104 is at cutoff and Q8103 is conducting.

The leading edge of the negative gate at the collector of Q8107 is differentiated by C8118 and R8143 and applied to the base of transistor Q8103 through diode CR8103. This disarming trigger reverts the armed multivibrator to its initial condition.

After the bistable delayed sweep gate multivibrator has been triggered, it will revert to its original state as determined by the setting of the SWP LENGTH adjustment R8159. The delayed sweep will remain inactivated until the armed multivibrator is rearmed by a signal from the delayed pick-off circuit.

The development of the strobe and unblanking pulses are identical to that described for the triggered-delayed mode. Automatic provision is made for turning off the NDT sweep when the DA sweep has terminated. This prevents brightening of the sweep retrace in the strobe position.

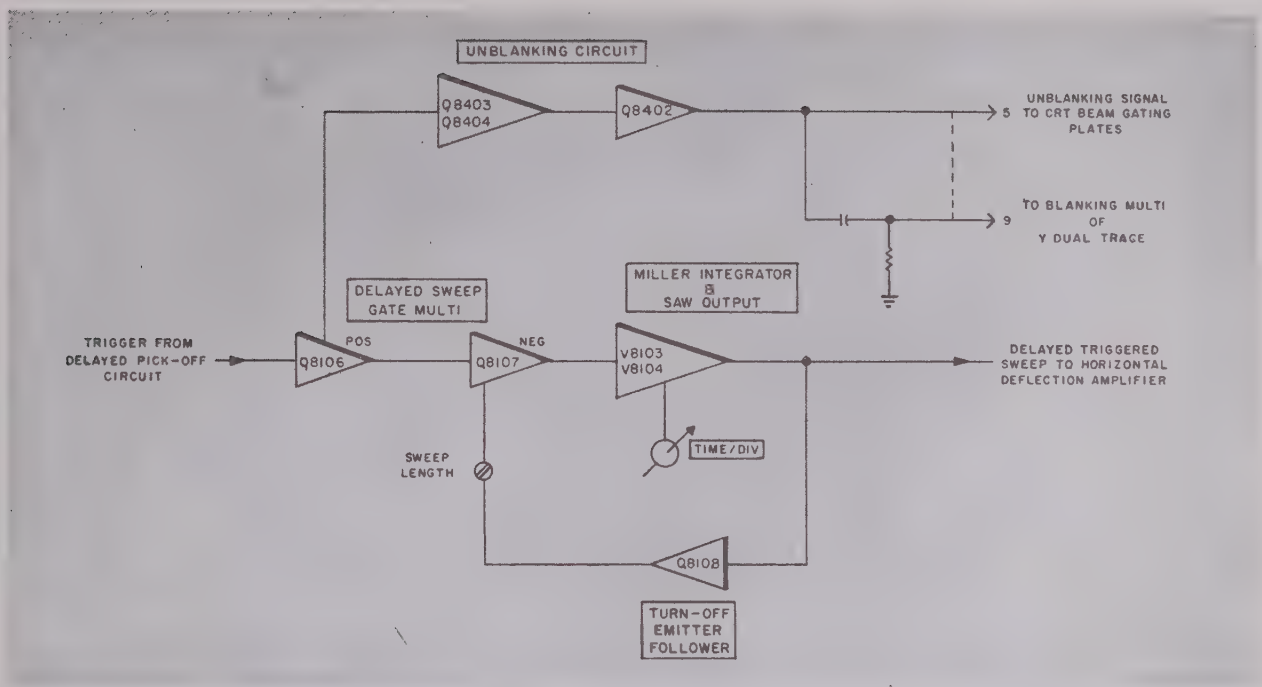


Figure 3-6. Delayed-Triggered Mode, Functional Block Diagram

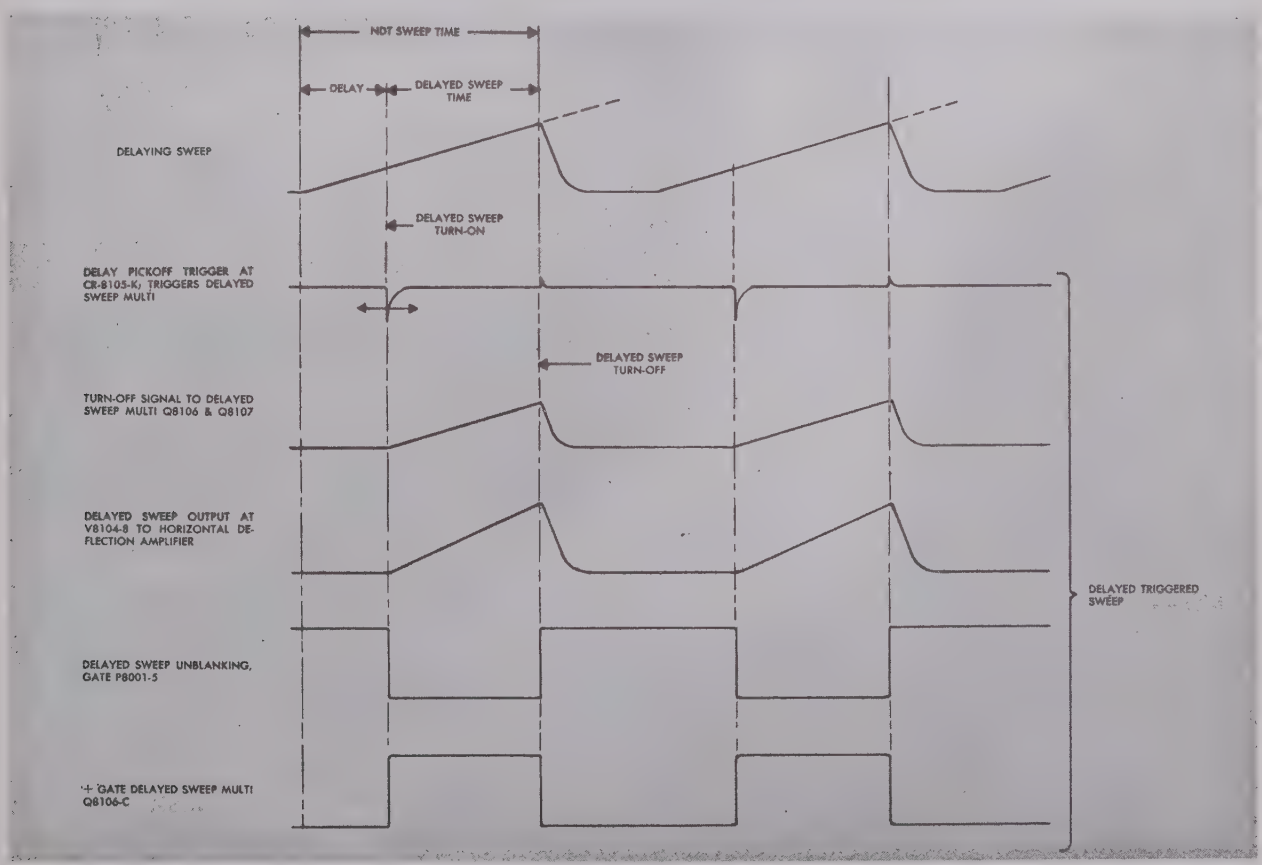

NDT SWEEP TIME
DELAY
DELAYED SWEEP TIME
DELAYING SWEEP
DELAYED SWEEP TURN-ON
DELAY PICKOFF TRIGGER AT CR-8105-K; TRIGGERS DELAYED SWEEP MULTI
DELAYED SWEEP TURN-OFF
TURN-OFF SIGNAL TO DELAYED SWEEP MULTI Q8106 & Q8107
DELAYED SWEEP OUTPUT AT V8104-8 TO HORIZONTAL DEFLECTION AMPLIFIER
DELAYED TRIGGERED SWEEP
DELAYED SWEEP UNBLANKING, GATE P8001-5
+ GATE DELAYED SWEEP MULTI Q8106-C

Figure 3-7. Simplified Timing Diagram for Delayed-Triggered Display

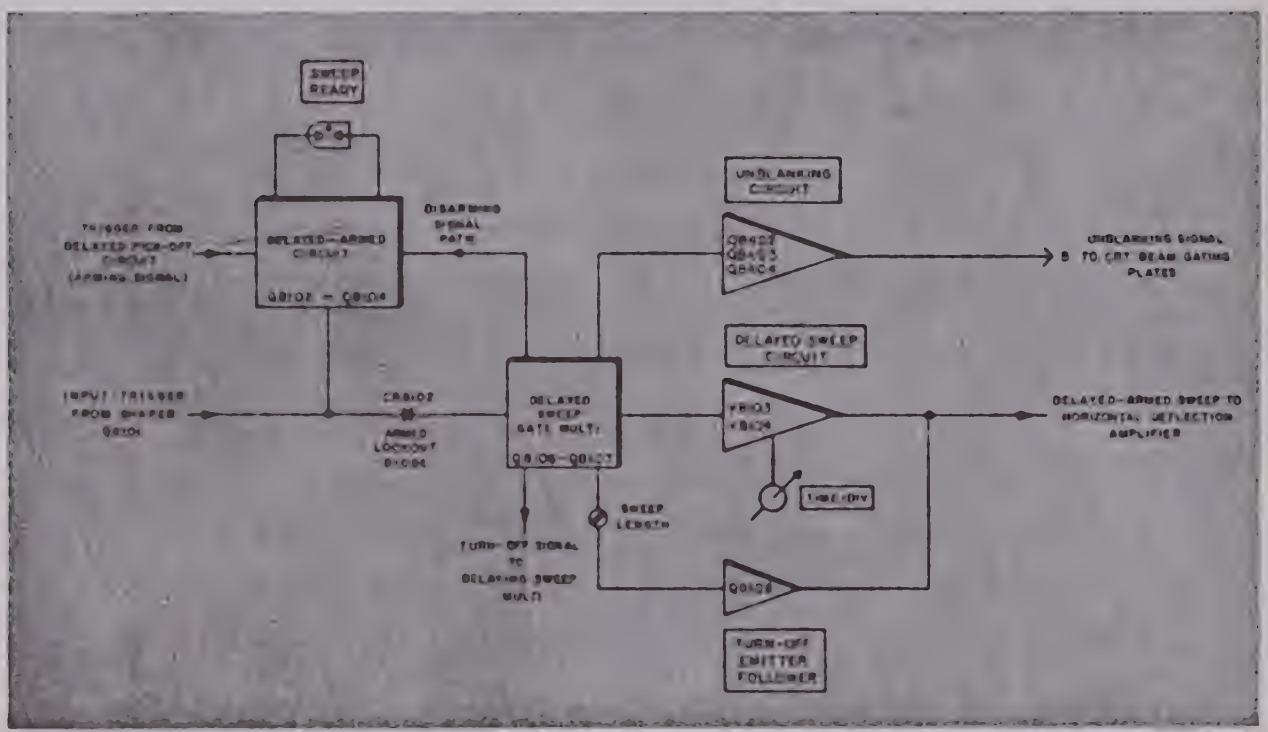


Figure 3-10. Delayed-Armed Mode, Functional Block Diagram

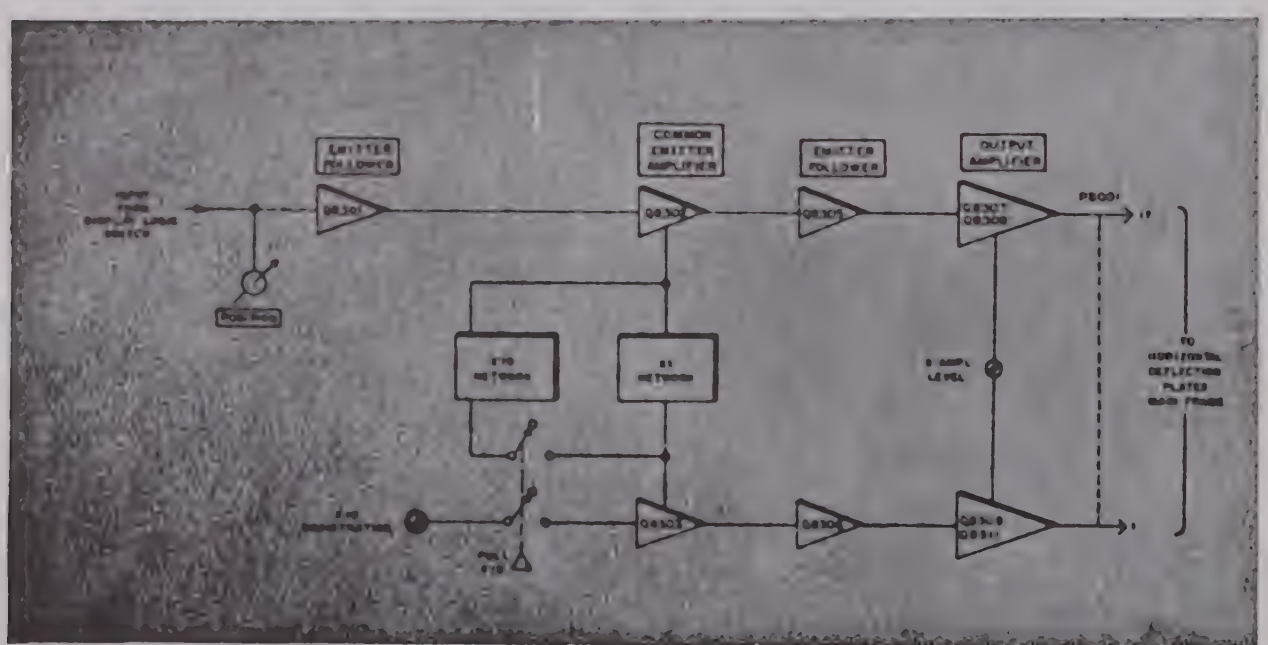


Figure 3-12. Horizontal Deflection Amplifier, Functional Block Diagram

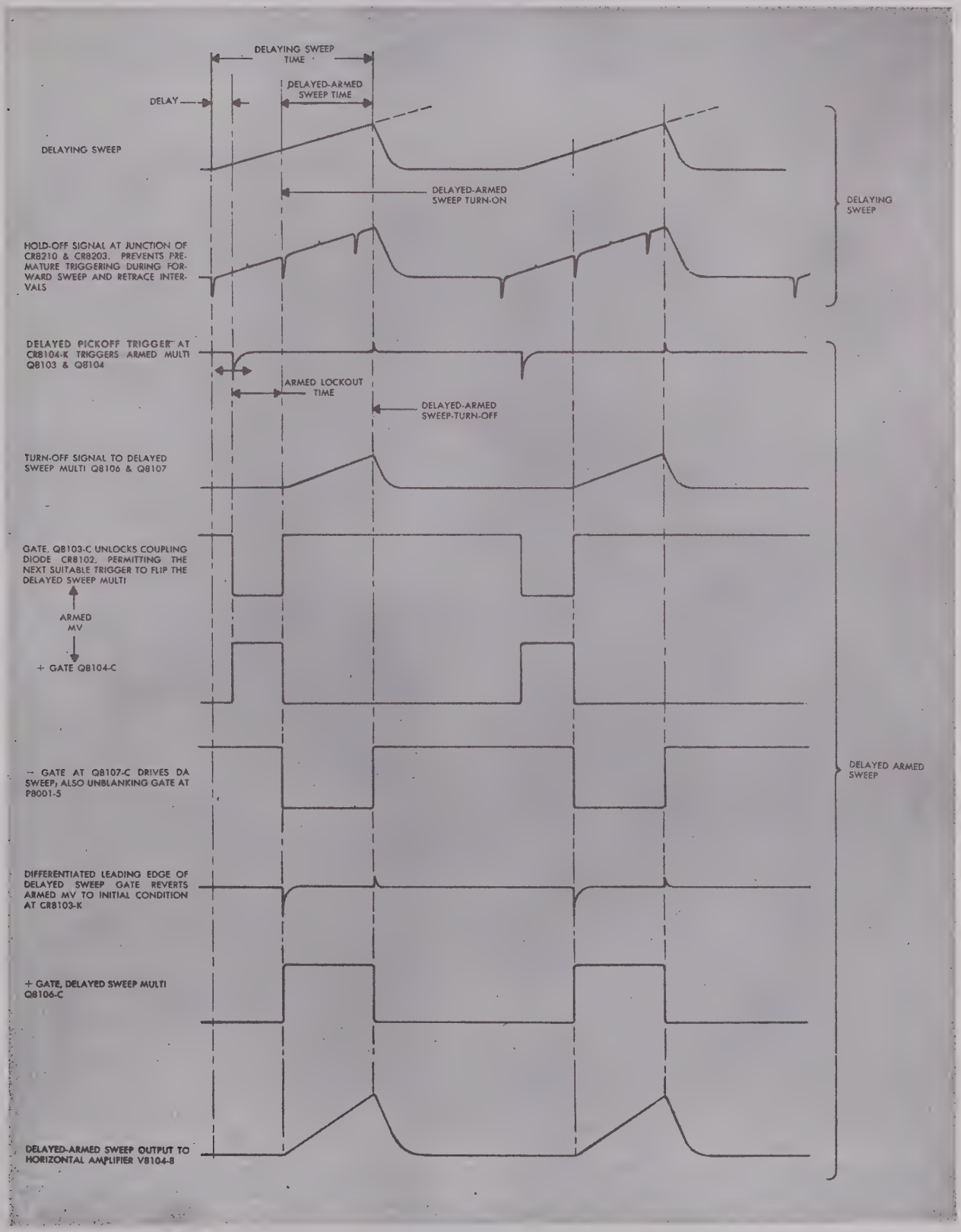

DELAYING SWEEP TIME
DELAYED-ARMED SWEEP TIME
DELAY
DELAYING SWEEP
DELAYED-ARMED SWEEP TURN-ON
DELAYING SWEEP
HOLD-OFF SIGNAL AT JUNCTION OF CR8210 & CR8203. PREVENTS PREMATURE TRIGGERING DURING FORWARD SWEEP AND RETRACE INTERVALS
DELAYED PICKOFF TRIGGER AT CR8104-K TRIGGERS ARMED MULTI Q8103 & Q8104
ARMED LOCKOUT TIME
DELAYED-ARMED SWEEP-TURN-OFF
TURN-OFF SIGNAL TO DELAYED SWEEP MULTI Q8106 & Q8107
GATE, Q8103-C UNLOCKS COUPLING DIODE CR8102, PERMITTING THE NEXT SUITABLE TRIGGER TO FLIP THE DELAYED SWEEP MULTI
ARMED MV
+ GATE Q8104-C
– GATE AT Q8107-C DRIVES DA SWEEP; ALSO UNBLANKING GATE AT P8001-5
DELAYED ARMED SWEEP
DIFFERENTIATED LEADING EDGE OF DELAYED SWEEP GATE REVERTS ARMED MV TO INITIAL CONDITION AT CR8103-K
+ GATE, DELAYED SWEEP MULTI Q8106-C
DELAYED-ARMED SWEEP OUTPUT TO HORIZONTAL AMPLIFIER V8104-8

Figure 3-11. Simplified Timing Diagram for Delayed-Armed Display

NOTES

SECTION 4
PERFORMANCE ASSURANCE TEST

4-1. MAINTENANCE CHECK TO ASSURE PERFORMANCE

The tests described in the paragraphs to follow should be performed by Instrument Test Departments and Maintenance Laboratories to certify proper performance. These tests are divided into sections for simplification and to assist those test groups where complete checking is not mandatory, or where all test equipment is not available. Refer to Section 5, paragraph 5-5, for list of test equipment required.

All tests are performed with a representative Type 765 Series Main Frame Oscilloscopes and a Y Amplifier Plug-in. Both of the plug-in units must be normalized to the Main Frame before starting tests. This is accomplished by adjusting the front-panel screwdriver SWP CAL and GAIN CAL controls as described in the appropriate Plug-in Instruction Manuals. Allow 30 to 60 minutes of warm-up time before making any adjustments.

NOTE

If this Plug-in module is checked by a Receiving Inspection laboratory, the tests outlined below are recommended to certify performance. This instrument has been thoroughly tested and aged at the factory. Nevertheless, rough shipment, extreme environments, or long idle periods may necessitate minor adjustments of the controls. Hence, it is suggested that the certifying engineer try the recommended adjustments not only for recentering the controls, but also to ascertain their range and to familiarize himself with this precision instrument. If, after performing all the tests outlined in the paragraphs to follow, the instrument will not perform to specification, the assistance of the local Dumont Field Engineering representative should be requested.

4-2. CHECKING SWEEP CALIBRATION

1. Connect a Time-Mark Generator to the Input connector of the Y Plug-in through a properly terminated cable.

2. Set up the instrument for NORMal sweep. Sweep accuracy is checked by counting the positive peaks in the centered 8-division portion of the CRT scale. Make sure the UNCAL lamp is off and refer to the following Sweep Check Calibration Chart for additional data. All measurements indicated in this chart should fall within ±0.25 division of the 9-division marking.

3. Repeat checks for the DELAYED TRIGGER position.

4-3. CHECKING TRIGGER SOURCE AND POLARITY

1. Preset front-panel controls as indicated:

Control	Setting
TRIG LEVEL	Zero
DISPLAY LOGIC	NORM
Trigger SOURCE	LINE
Trigger COUPLING	AC
Trigger SLOPE	+
TIME/DIV (both knobs)	10 mSEC
TIME/DIV Vernier	CAL (fully cw)
VOLTS/DIV (Y Plug-in)	CAL
PULL X10	Pushed in (X1)
POSITION	Centered
SWP MODE	CONT

2. Six cycles of the calibrator pattern should be observed on the screen for 60-cycle line, 5 cycles for 50-cycle line.

3. Set the NDT Trigger SOURCE switch to INT; the pattern remains stationary on the screen.

4. Set the NDT Trigger SOURCE switch to EXT; the display should disappear.

5. Apply a line frequency sine wave signal of 0.5V peak-to-peak to the NDT EXT TRIG connector. The amplitude of this signal should be sufficient to trigger the sweep and the pattern should again remain stationary on the screen. The 0.5 volt test signal is suitably attenuated by the 80-cycle cutoff frequency of the AC coupling and represents a true measure of trigger sensitivity.

6. Changing the NDT Trigger SLOPE switch from plus to minus should change the leading edge of the first cycle from positive-going to negative-going.

7. Reset the NDT Trigger SOURCE and SLOPE switches to INT and plus respectively.

8. Set DISPLAY LOGIC switch to DELAYED ARMED and adjust DELAY VERNIER control until the calibrator pattern appears on the screen.

9. Set the DA Trigger SOURCE switch to INT; the delayed-armed display should remain stationary on the screen.

10. Set the DA Trigger SOURCE switch to EXT; the delayed-armed display should disappear.

11. Repeat steps 5, 6, and 7 except that the DA EXT TRIG connector, the DA Trigger SOURCE and SLOPE switches are used.

SWEEP CHECK CALIBRATION CHART

TIME-MARK GEN set to	TIME/DIV set to	NUMBER OF POSITIVE PULSES*
50 Mc sine wave	0.1 μSEC	(6**)
10 Mc sine wave	0.1 μSEC	9 cycles (2**)
5 Mc sine wave	0.2 μSEC	9 cycles
1 μsec marker	0.5 μSEC	5 timing markers
1 μsec marker	1 μSEC	9 timing markers
1 μsec marker	2 μSEC	17 timing markers
5 μsec marker	5 μSEC	9 timing markers
10 μsec marker	10 μSEC	9 timing markers
10 μsec marker	20 μSEC	17 timing markers
50 μsec marker	50 μSEC	9 timing markers
100 μsec marker	0.1 mSEC	9 timing markers
100 μsec marker	0.2 mSEC	17 timing markers
500 μsec marker	0.5 mSEC	9 timing markers (2**)
1 msec marker	1 mSEC	9 timing markers
1 msec marker	2 mSEC	17 timing markers
5 msec marker	5 mSEC	9 timing markers
10 msec marker	10 mSEC	9 timing markers
10 msec marker	20 mSEC	17 timing markers
50 msec marker	50 mSEC	9 timing markers
100 msec marker	0.1 SEC	9 timing markers
100 msec marker	0.2 SEC	17 timing markers
500 msec marker	0.5 SEC	9 timing markers
1 sec marker	1 SEC	9 timing markers
1 sec marker	2 SEC	17 timing markers

* Centered 8-division portion of scale.

** Expander check (Pull X10 switch out). Number of positive pulses between 10 div, ±0.8 div are indicated by numbers in parenthesis. Neglect the first 50 nanoseconds of the sweep. In addition, the centered sweep should be within 10 div, ±0.2 div.

4-4. CHECKING NORMAL, TRIGGERED & ARMED SWEEP DISPLAYS

Refer to the following illustrations in Section 2, Operation, to check the sweep modes available at the different settings of the DISPLAY LOGIC switch.

Figure 2-2. Type 74-13A Normal Display

Figure 2-3a. Type 74-13A Triggered Strobe Display

Figure 2-3b. Type 74-13A Delayed Triggered Display

Figure 2-4a. Type 74-13A Armed Strobe Display

Figure 2-4b. Type 74-13A Armed Delayed Display

Unless otherwise designated, it is presumed that a Y Amplifier Plug-in module is inserted in the Y cavity (left-hand side) and the Type 74-13A Calibrated Delaying Sweep Plug-in unit is inserted in the X cavity (right-hand side) of the Main Frame.

4-5. DELAY CALIBRATION CHECK

1. Allow the unit to warm up at least 10 minutes at an ambient temperature of 25°C ±5°C (77°F ±9°F).

2. Apply a 100 μsec marker from a Time-Mark Generator to the Input connector of the Y Plug-in unit through a properly terminated cable.

3. Set NDT TIME/DIV switch to 0.1 mSEC and DA TIME/DIV switch to 5 μSEC.

4. Set the DISPLAY LOGIC switch to Triggered DELAYED.

5. Measure the incremental accuracy of the delay calibration from 0.8 div to 9.8 div in steps of 1 div (i.e., 1.8 div, 2.8 div, etc.). One complete revolution of the DELAY VERNIER dial, say from 3.8 div to 4.8 div, should bring the succeeding pulse back to the position occupied by the preceding pulse within ±1 div.

Note: Be sure that the Positioning and Trigger Leveling settings are not disturbed during this check.

6. Center the pulse when the dial is set to 9.8 div. Turning the DELAY VERNIER dial back to 0.8 div should bring the pulse back on screen within ±2 div from the center line.

4-6. NDT GATE OUT CHECK

1. Set DISPLAY LOGIC switch to NORM.

2. Apply the NDT + GATE signal to the input connector on the Y Plug-in module. The display should be a positive-going step with an amplitude of approximately 2.5 volts.

4-7. NDT SAW OUT CHECK

1. With the DISPLAY LOGIC switch set to NORM, apply the SAW signal to the input connector on the Y Plug-in module.

2. The display should be a positive saw waveform with an amplitude of approximately 25 volts.

4-8. DUAL TRACE SWITCH TRIGGERING CHECK

This check is to determine whether the Type 74-13A Delaying Sweep Module triggers the Type 76-02A Dual Trace Module when the latter unit is set up for alternate display.

Set up the Delaying Sweep unit as follows:

Control	Setting
TIME/DIV	10 μSEC
DISPLAY LOGIC	DELAYED TRIGGERED
Trigger SOURCE	INT
Trigger COUPLING	ACF

Set Type 76-02A MODE switch to ALT and observe alternate displays of the Dumont Type 791A waveforms into both Type 76-02A inputs at a frequency range of 10 to 30 Kc in each vertical channel.

Adjust the amplitude of the Y signal for 2 to 2½ divisions peak-to-peak vertical deflection. Two similar signals should be displayed on the screen. Check that both displays may be positioned independently with their respective Y POSITION controls.

4-9. BEAM POSITIONING INDICATOR CHECK

Set up the front panel controls as indicated in step 1 of paragraph 4-3 to obtain a calibrated pattern on screen. Reduce the intensity of the beam. Vary the POSITION control. Check that the right beam position indicator is lit when the display is positioned off screen to the right; and conversely, the left indicator is lit when the display is positioned off screen to the left. Both beam position indicators should be off when beam is positioned on screen.

4-10. AUTO TRIGGERING AND HF SYNC CHECK

1. Set the DISPLAY LOGIC switch to NORM and the Sweep Mode toggle switch to NORM.
2. Apply a 10 cps signal (sinusoidal or any other waveform) to the input connector of the Y Plug-in and check that the oscilloscope triggers properly in the NORM and AUTO modes.
3. Check whether the unit free runs after the removal of the triggering signal from 10 cps to 10 Mc. Free running should stop immediately after the reapplication of the triggering signal.
4. Set the Sweep Mode toggle switch to HF RECUR.
5. Apply a 50-megacycle signal to the input connector of the Y Plug-in and set display for 1 division of vertical deflection.
6. Using internal triggering, adjust the NDT TRIG LEVEL control for a stable display on screen.

NOTES

SECTION 5
MAINTENANCE AND RECALIBRATION

5-1. INTRODUCTION

This section of the manual contains service information and procedures for internal adjustments.

5-2. REMOVAL AND REPLACEMENT OF PARTS

If it is necessary to order a replacement component from the factory, always give the Type Number and Serial Number of the instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in this manual. The Parts List gives the values, tolerances, ratings, and the factory part number for all electrical components used in the instrument. This will help to expedite service.

Since your instrument left the factory, some of the parts may have been superseded by improved components. In such cases, the part numbers of these new components will not be listed in your Parts List. However, if you order a part from the factory, and it has been superseded by an improved component, the new part will be shipped in place of the part ordered.

It is the aim of the Dumont organization to make available the most reliable commercial oscilloscopes within the state of the art and to provide services which will help the user to rapidly restore any of our equipment to its specified performance. Your local Field representative maintains a limited number of spare parts. Also the factory may be asked to air-ship replacement parts on a rush basis.

NOTE

Be sure and replace the beryllium oxide insulating washers (they serve as heat sinks) on the transistors that require them. Always grease these heat sinks with Dow Corning silicon grease for optimum heat transfer.

5-3. SERVICING HINTS

General maintenance and trouble-shooting information is given in the Type 765 Series Oscilloscope Instruction Manual. In the following discussion, it is assumed that you have already read that information and have definitely isolated a trouble in the Time Base Plug-in unit.

In trouble shooting a Plug-in unit, it becomes necessary to determine if the defect is in the plug-in or in the Main Frame of the oscilloscope. The quickest and easiest way of isolating the trouble is to substitute another plug-in unit and determine if the same trouble persists. If the trouble continues after substitution, it can be safely assumed that the defect is in the Main Frame.

There is no simple way of locating troubles. An understanding of the functions of the circuits is the best help. With an understanding of the circuit operation, it will be possible to make a good guess at the general source of troubles from the symptoms. As an aid in trouble-shooting this unit, refer to the functional block and timing diagrams in this Section and to the schematics.

To keep electronic units operating at top performance, it is desirable to check the equipment at regular intervals. The period between checks will depend on the installation and the conditions of operation. For these regular checks, clean all dust and dirt from the unit using a light air blast or soft brush. However, to insure the reliability of measurements, we suggest that you recalibrate the plug-in after each 500 hours of operation or every six months if used intermittently. Also, the calibration of a unit should always be fully checked and adjusted after the repair or replacement of any component in the unit. The complete adjustment procedure for this unit is given in this Section of the Instruction Manual.

In the event of improper performance of the Plug-in unit, the following suggestions are recommended:

1. The Type 7024A Extension Cable for remote operation of the plug-in from the oscilloscope is available as an accessory. This plug-in extender will be helpful for routine maintenance and recalibration. Do not use this extension for HF alignments; instead remove the Main Frame side cover.

2. Localizing the trouble is made easier by use of a test oscilloscope to check waveforms. These waveforms are shown at key points on the over-all schematics. Both the waveform amplitude and time duration are given Use a high-impedance 10:1 Passive Attenuator Probe while trouble shooting (Dumont Type 4290 Series). A Dumont Type 765 Series Oscilloscope with a Y Plug-in having a bandwidth from dc to 25 Mc is recommended.

3. Maintain a high quality of workmanship. Use a clean bench and soldering iron; keep solder joints smooth and bright; do not overheat any component while soldering. Use heat sinks when soldering semiconductors. The use of a 30-watt iron such as a Hexacon Type 26S is recommended.

4. When using accessory probes or adapters, be sure the trouble is not originating in the accessory before suspecting the instrument itself.

5. Once the defective stage has been localized, the component or components causing the trouble can be located by tube and component substitution or by voltage measurement. Key voltage measurements are shown on the over-all schematics at the rear of this manual.

6. The identification of electron tubes, semiconductors and service adjustments are shown on photographs in this Section of the Instruction Manual.

5-4. GAINING ACCESS TO CHASSIS

Since the Plug-in is not contained in its own dust cover, most of the components are readily accessible when the plug-in is removed from the Main Frame. To gain access to the chassis, simply unscrew the knurled thumbscrew at center bottom of unit and pull it free of the Main Frame.

WARNING

WHEN THE PANELS OR PLUG-INS ARE REMOVED FROM THE INSTRUMENT FOR SERVICING, EXERCISE CAUTION WHILE THE POWER IS ON. The lower-voltage busses are potentially more dangerous than the cathode-ray tube potential because of the high current capabilities and large filter capacitors employed in these supplies. When you reach into the instrument with one hand while it is turned on, do not grasp the metal frame with the other hand. If possible, stand on an insulated floor and use insulated tools. It is advisable to ground the third lead in the power cord whenever the instrument is in use.

5-5. TEST EQUIPMENT REQUIRED FOR SERVICE ADJUSTMENTS

a. Introduction

The adjustments outlined in the following paragraphs are based on the test procedure followed at the factory. All adjustments should be made at mid-line voltage, 115V/230V ±2%.

To set up the Time Base Unit for calibration, insert an amplifier plug-in and the Time Base plug-in into the Main Frame. The amplifier plug-in module and the Main Frame must be fully tested and certified units.

CAUTION

Always use insulated tools while working or making adjustments on the unit when power is on. The transistors in this instrument may be damaged if overvoltaged by accidental grounding of one or more elements. Exercise caution and turn off power when making repairs.

b. Test Equipment Required (Equivalent may be substituted)

Equipment	Description
Oscilloscope	Fully tested and certified Type 766 Series Main Frame
Y Plug-In	Type 76-02A with delay line installed
X Plug-In	Type 74-03A
Volt-ohmmeter	Simpson Model 260; 20K ohms/volt sensitivity
Square Wave Generator	Dumont Type 791
Time-Mark Generator	Dumont Type 781A
Differential Voltmeter	John Fluke Model 801B
Type 4290B	10:1 Passive Attenuator Probe
Alignment Tools	Dumont Type 7013 Tool Kit

Preset front-panel controls on the Type 74-13A as indicated:

Control	Setting
SWP MODE	CONT
TRIG LEVEL	ZERO
DISPLAY LOGIC	NORM
Trigger SOURCE	EXT
Trigger COUPLING	DC
Trigger SLOPE	+
TIME/DIV (NDT & DA)	10 mSEC
TIME/DIV Vernier	CAL (fully cw)
VOLTS/DIV (Y Plug-in)	OFF
PULL X10	Pushed in (X1)
POSITION	Centered
NORM-AUTO-HF RECUR	NORM

5-6. NDT & DA TRIG SENS ADJUSTMENT (R8229 & R8118)

1. Preset front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	NORM
NDT Trigger SOURCE	EXT

2. While gently rocking the NDT LEVEL control back and forth, turn the NDT TRIG SENS potentiometer R8229, gradually clockwise until a trace just appears on the screen. This indicates that tunnel diode CR8201 is now free-running.

3. Back off on the NDT TRIG SENS potentiometer R8229 until the trace just disappears. Turn the NDT LEVEL control back and forth and note that the trace flashes momentarily on the screen but disappears when the NDT LEVEL control is not turned.

4. Preset front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	DELAYED ARMED
NDT Trigger SOURCE	LINE
DA Trigger SOURCE	LINE

5. Adjust the DA LEVEL control for a trace on the screen.

6. Set DA Trigger SOURCE switch to EXT; the trace should disappear.

7. While gently rocking the DA LEVEL control, turn the DA TRIG SENS potentiometer R8118 gradually clockwise until a trace just appears on the screen. This action indicates that tunnel diode CR8101 is now free-running.

8. Back off on the DA TRIG SENS potentiometer R8118 until the trace just disappears. Rock the DA LEVEL control and note that the trace appears momentarily on the screen but disappears when the DA LEVEL control is not turned.

5-7. TRIG BAL ADJUST (R8100, R8234)

1. Set DISPLAY LOGIC switch to NORM.

2. Apply a 1 Mc signal to Type 76-02A and set up instrument for 1 division of deflection.

3. Adjust NDT TRIG BAL potentiometer R8234 such that the trace remains on the screen while switching the Trigger SLOPE switch back and forth from (+) to (−)

4. Set DISPLAY LOGIC switch to DELAYED ARMED. Repeat steps 2 and 3 adjusting the DA TRIG LEVEL potentiometer R8100.

5-8. X AMPLIFIER OUTPUT LEVEL ADJUSTMENT (R8339)

1. Set the DISPLAY LOGIC switch to X AMP, the DA Trigger SOURCE switch to EXT, and the Y amplifier VOLTS/DIV switch to CAL.

2. Adjust the POSITION control so that the vertical line is centered on the screen, and do not touch this control again.

3. Connect a temporary shorting jumper between pins 1 and 17 of P8001.

CAUTION

Exercise care to avoid accidentally shorting pins 1 and 17 to ground.

4. Connect a voltmeter, set to the 250-volt dc scale, from pins 1 and 17 (tie point) to ground.

5. Adjust R8339 X AMPL LEVEL potentiometer for a meter reading of 90 volts ± 3 volts (make sure that the measurement does not introduce any oscillations in the X amplifier).

6. Carefully disconnect the meter and the jumper.

5-9. NDT SWEEP LENGTH ADJUSTMENT (R8263)

1. Preset front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	NORM
Trigger SOURCE	LINE
Trigger SLOPE	+
VOLTS/DIV (Y Plug-in)	CAL

2. Adjust the NDT SWEEP LENGTH potentiometer R8263 until the display occupies 10.5 to 10.7 divisions.

5-10. SLOW SWEEP CAL ADJUST (Front Panel)

1. Preset front-panel controls as indicated in paragraph 5-9, and obtain a display.

2. Adjust SWP CAL front-panel screwdriver control until 6 cycles of the calibrator signal appears precisely in 10 divisions (60-cycle line), 5 cycles for 50-cycle line.

Note: Make certain that the UNCAL lamp is *off* during these adjustments.

5-11. DA SWEEP LENGTH ADJUSTMENT (R8159)

1. Preset front-panel controls as indicated in paragraph 5-9, to obtain a NORMal sweep display.

2. Set DISPLAY LOGIC switch to DELAYED TRIGGERED.

3. Adjust DA SWEEP LENGTH potentiometer R8159 until the display occupies 10.5 to 10.7 divisions of deflection.

5-12. SWEEP RATE BAL ADJUSTMENT (R8175)

The SWEEP RATE BAL potentiometer is adjusted to normalize the tracking between the NDT and DA Sweep rates. Once both time bases are normalized, the SWP CAL panel control will calibrate both time bases simultaneously. The SWEEP RATE BAL potentiometer normally requires readjustment only when the timing components and V8103 or V8203 are replaced. To adjust, proceed as follows:

1. Preset front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	NORM
Trigger SOURCE (NDT)	LINE
Trigger SLOPE (NDT)	+
TIME/DIV (NDT & DA)	10 mSEC
VOLTS/DIV (Y Plug-in)	CAL

The calibrator signal should be displayed on the screen.

2. Set DISPLAY LOGIC switch to DELAYED TRIGGERED.

3. Switch back and forth between the DELAYED TRIGGERED and NORMAL displays and adjust the SWEEP RATE BAL potentiometer R8175 until both sweep rates are identical.

4. Readjust the SWP CAL front-panel screwdriver control to again have 6 cycles of the calibrator signal to displace exactly 10 divisions (60-cycle line).

5. Recheck the Normal and the Delayed Triggered mode to make sure that the SWEEP RATE BAL potentiometer has equalized both time bases. The calibrator signal must occupy equal display divisions for both time bases on the screen. Error between time bases must be less than 0.1 major division of sweep for compliance of sweep calibration specifications.

5-13. X10 REGISTRATION (R8311)

1. Position the pattern so that the leading edge of one of the calibrator signals is coincident with the vertical center line of the scale.

2. Pull out the X10 knob (concentric with the DISPLAY LOGIC knob).

3. Adjust the X10 REGISTRATION potentiometer R8311 until the leading edge of the same pulse (see step 1) is again coincident with the vertical center line of the scale (within $\pm\frac{1}{2}$ division).

4. Push in the X10 knob.

5-14. X AMPLIFIER HIGH-FREQUENCY ADJUSTMENTS (C8119, C8317 & C8101)

1. Replace the Plug-in Amplifier in the Y cavity with a tested Time Base plug-in unit. This unit is then set up to obtain a vertical sweep.

Note; Unless otherwise noted, the test procedure for the balance of this setup pertains to the Time Base unit inserted in the X cavity.

2. Set DISPLAY LOGIC switch to X AMP and the DA SOURCE to EXT.

3. Rotate X AMP ATTEN control fully clockwise.

4. Apply a 100 Kc square wave signal from the Fairchild Type 791A Generator through a properly terminated cable to the EXT TRIG/X AMP panel connector.

5. Adjust amplitude of the square wave pattern for 2 divisions peak-to-peak about the scale center. In other words, 1 division to the left and 1 division to the right of the scale center line.

6. Adjust trimmer C8119 for a flat-top display.

7. Set the Square Wave Generator to 1 Mc and adjust oscilloscope controls for a 2-cycle pattern on the screen.

8. Center the pattern and adjust its amplitude the same way as was done in step 5.

9. Adjust trimmer C8317 until best flat-top and rise time is achieved.

10. Pull out the PULL X10 magnification control and reduce square wave amplitude to give previous display.

11. Set the Square Wave Generator to 100 Kc.

12. Pull out the DA PULL EXT/10 switch and increase the signal level to obtain 2 divisions of deflection.

13. Adjust trimmer capacitor C8101 for optimum flat-top display.

14. Repeat steps 9 thru 13 for optimum square-wave response.

15. Disconnect generator and push in the DA PULL EXT/10 and the PULL X10 magnification controls.

5-15. X AMP DC BALANCE ADJ (R8105)

1. Set up the Type 74-03A for automatic triggering and observe vertical line.

2. Adjust the DC BAL potentiometer R8105 until there is no horizontal depositioning of the trace while rocking the X AMP ATTEN control throughout its range.

3. Remove the Time Base unit from the Y cavity.

5-16. FAST SWEEP CALIBRATION ADJUSTMENT (C8556, C8606, C8506, C8137, and C8317)

1. Make the following front-panel settings with the Type 76-02A or equivalent Y Plug-in in the Y cavity.

Control	Setting
DISPLAY LOGIC	NORM
NDT & DA TIME/DIV	1 μS
NDT & DA SOURCE	INT

2. Apply a 1-microsecond time-marker signal from a Fairchild Type 781A Generator through a properly terminated cable to the input connector on the Y Plug-in.

3. Adjust the VOLTS/DIV switch to give the display a vertical amplitude of about 4 divisions.

4. Using an insulated screwdriver, adjust trimmer capacitors C8556 and C8606 until 11 markers from the generator occupy 10 divisions.

5. Set the DISPLAY LOGIC switch from NORM to TRIG DLY'D and adjust trimmer capacitors C8506 and C8137 until 11 markers from the generator occupy 10 divisions.

6. Set the DISPLAY LOGIC switch from TRIG DLY'D to NORM and the NDT and DA TIME/DIV switches to 0.1 microsecond.

7. Reset the Time-Mark Generator for a 10-megacycle sine wave signal and adjust trimmer capacitors C8606 until 11 peaks occupy 10 divisions.

8. Set the DISPLAY LOGIC switch from NORM to TRIG DLY'D and adjust trimmer capacitor C8137 until 11 peaks occupy 10 divisions.

Note: If necessary repeat steps 1 through 8.

9. Reset the Time-Mark Generator for a 50-megacycle sine wave signal.

10. Pull out the PULL X10 magnification control and observe a 5-cycle sine wave display within 10 divisions. If not, adjust trimmer capacitor C8317 to bring calibration within ±2%.

11. Set the DISPLAY LOGIC switch to NORM and repeat the above procedure. All measurements should be made with the sweep approximately centered, including the X10 MAG positions.

5-17. STROBE INTENSITY AND PATTERN CORRECTION ADJUSTMENT (R8012, R8005 and C8004)

1. Apply a 5-millisecond time-marker signal from a Dumont Type 781A Generator through a properly terminated cable to the input connector on the Y Plug-in.

2. Reset the front-panel controls as indicated:

Control	Setting
DISPLAY LOGIC	TRIG STROBE
SLOPE	+
NDT TIME/DIV	50 μS
DA TIME/DIV	2 μS
PULL X10 (MAG)	Pushed in

3. Vary the DELAY VERNIER control until the strobed section of the display is in the middle of the trailing edge of the marker signal.

4. Adjust the STROBE ADJ potentiometer R8012 until a distinct contrast is produced.

5. The strobed section may be offset to either side of the trailing edge of the unstrobed marker signal. If it is, readjust the PATTERN CORR potentiometer R8005 until the strobe is superimposed on the marker signal.

6. Reset the Time-Mark Generator for a 100-microsecond output signal.

7. Set the NDT TIME/DIV switch to 0.5 μS and the DA TIME/DIV siwtch to 0.1 μS.

8. Vary the DELAY VERNEIR control until the strobed section of the display is in the middle of the trailing edge of the marker signal.

9. Adjust trimmer capacitor C8004 for minimum overshoot at both ends of the strobed section.

Note: Consider ambient light conditions and possible use of cameras and viewing hoods when making these adjustments.

5-18. DELAY ZERO ADJUSTMENT (R8618)

1. Set the NDT and DA TIME/DIV switches to 0.1 μSEC.

2. Set DISPLAY LOGIC switch to TRIG STROBE and obtain a convenient display.

3. Set DELAY VERNIER dial to Zero.

4. If the strobed section is still visible, adjust the front-panel screwdriver DELAY ZERO control until the strobed section just disappears.

5-19. DELAY CAL ADJUSTMENT (R8614)

1. Apply a 100-microsecond time-marker signal from Fairchild Type 781 Generator through a properly terminated cable to Input connector on the Y plug-in.

2. Set NDT TIME/DIV switch to 0.1 mSEC and DA TIME/DIV switch to 5 μSEC, and DISPLAY LOGIC switch to TRIG STROBE.

3. Set DELAY VERNIER dial to 5 division and adjust the DELAY CAL potentiometer R8614 so that the strobed section starts approximately at the 5-division mark.

4. Set DELAY VERNIER dial to 0.8 division and DISPLAY LOGIC switch to TRIG DLY'D.

5. Position the display so that the pulse is bisected by the vertical center line, ±0.05 division.

6. Advance the DELAY VERNIER dial to 5.8 division. (Be sure that the Positioning and Trigger LEVEL settings are not disturbed.)

7. Adjust the DELAY CAL potentiometer R8614, so that the pulse is again centered, ±0.05 division.

8. Back off DELAY VERNIER dial to 0.8 division and check whether or not the pulse is again centered. If not, center the pulse and recheck step 7. This procedure may have to be repeated several times until the 0.8 division pulse and the 5.8 division pulse are centered, ±0.05 division.

9. Measure the incremental accuracy of the delay calibration from 0.8 division to 9.8 division in steps of 1 division (i.e., 1.8 div, 2.8 div, etc.). One complete revolution of the DELAY VERNIER dial, say from 3.8 division to 4.8 division, should bring the succeeding pulse back to the position occupied by the preceding pulse within ±1 division. (Be sure that the Positioning and Trigger LEVEL settings are not disturbed during this check.)

10. Center the pulse when the dial is set at 9.8 division. Turning the dial back to 0.8 division should bring the pulse back on screen within ±2 division from the center line.

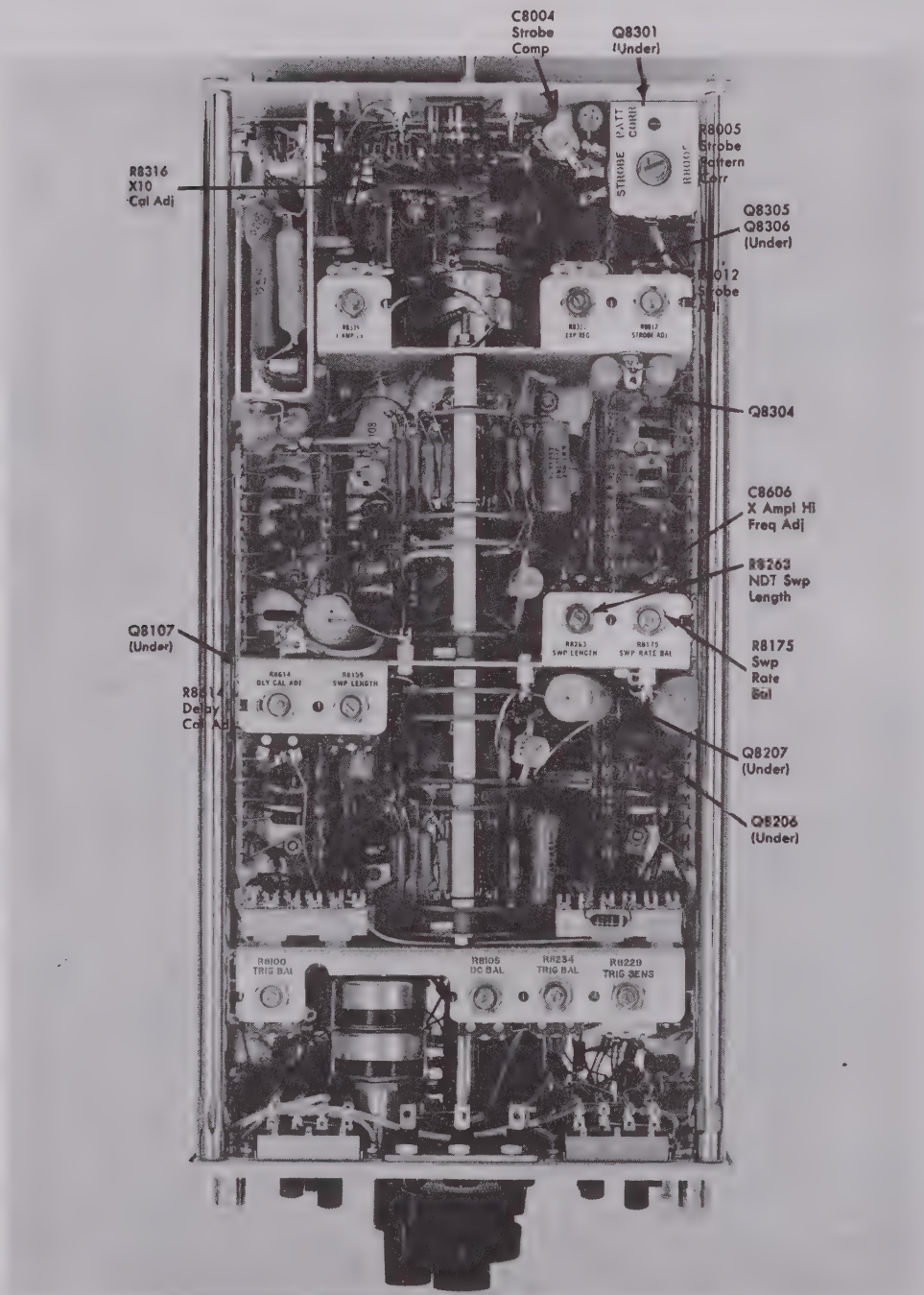


Figure 5-1. Right Side View Showing Transistors and Adjustments

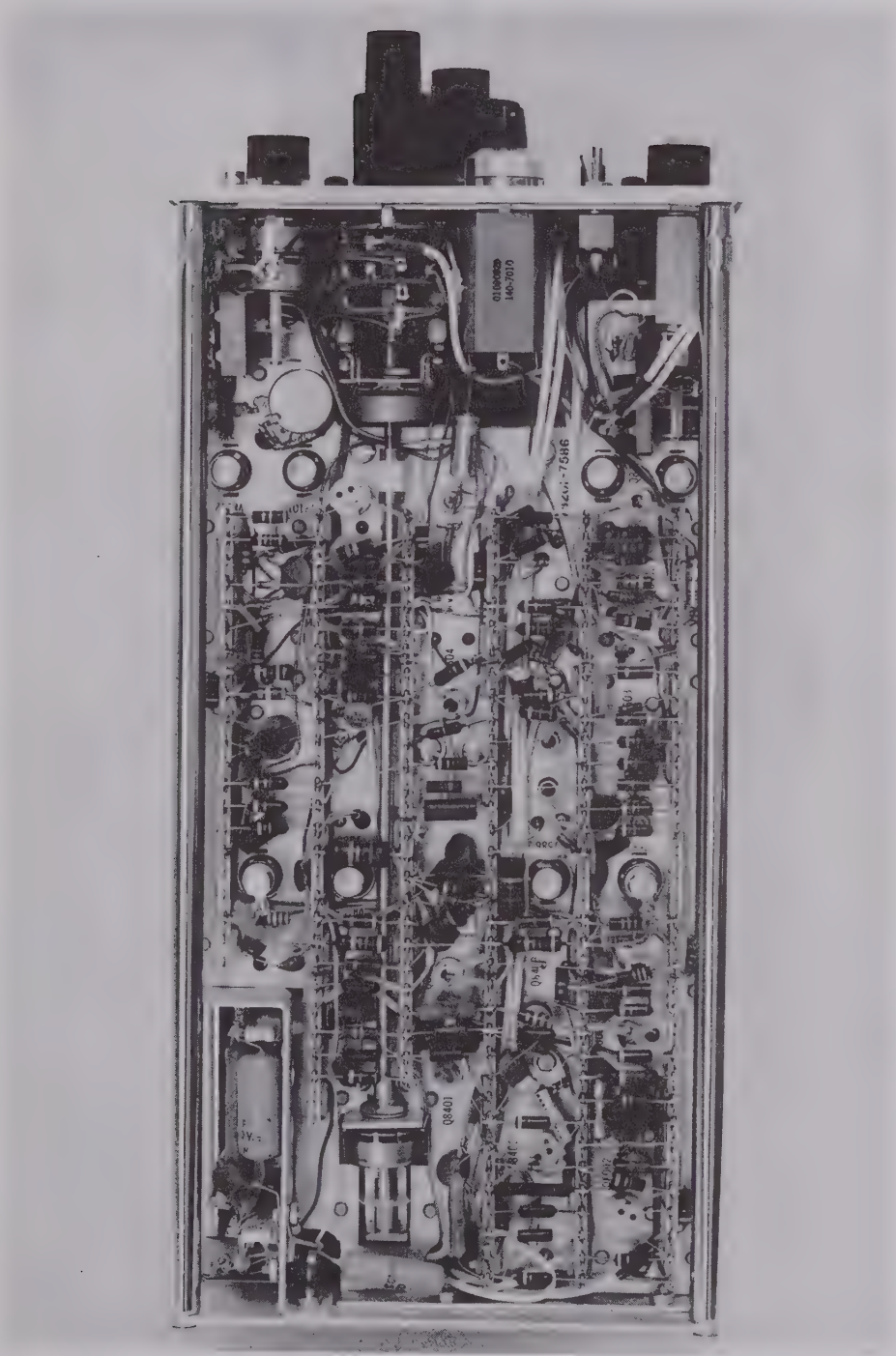


Figure 5-2. Left Side View Showing Transistors, Nuvistors and Adjustments

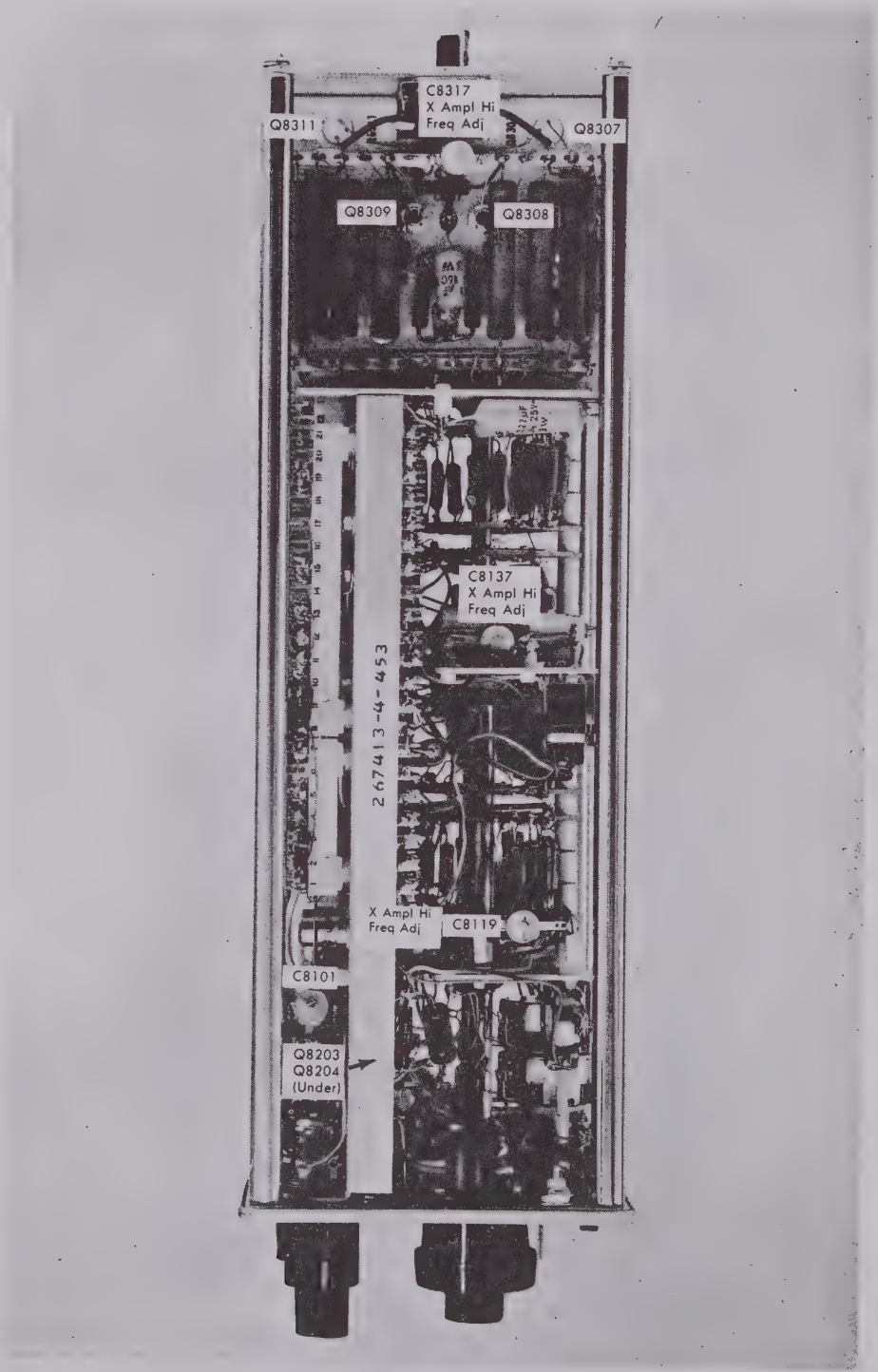


Figure 5-3. Top View Showing Transistors and Adjustments

5-20. X10 CALIBRATION ADJUSTMENT (R8316)

1. Set the Y VOLTS/DIV switch to 2.
2. Apply a 5-millisecond time-marker signal from a Dumont Type 781A Generator through a properly terminated cable to the input connector of the Y Plug-in.
3. Adjust the X10 CAL potentiometer R8316 until 2 marker signals occupy exactly 10 divisions.
4. Push in the X10 knob and check that 11 markers occupy 10 divisions.

SECTION 6
TYPE 74-13A
PARTS LISTS AND SCHEMATICS

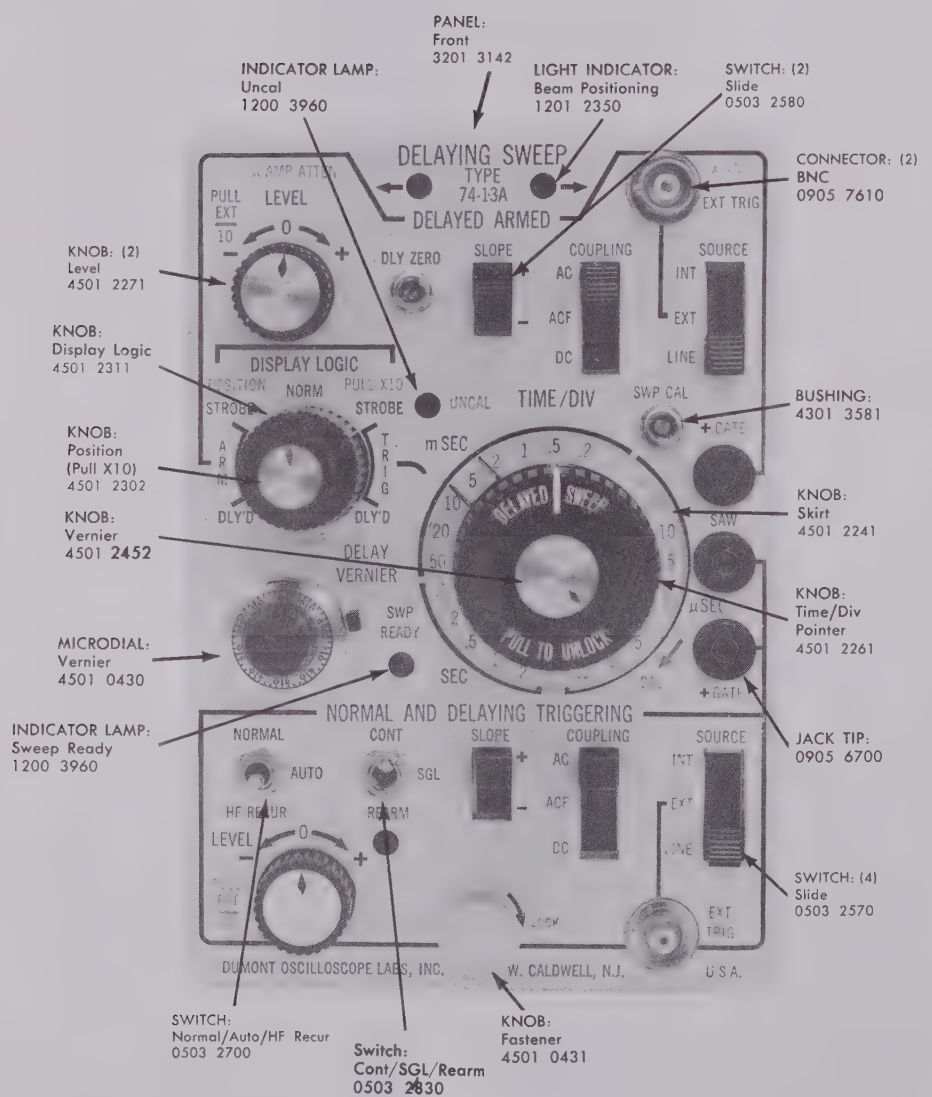


Figure 6-1. Front Panel Replaceable Parts

SECTION 6A
ELECTRICAL PARTS LIST AND SCHEMATICS

TYPE 74-13A CALIBRATED DELAYING SWEEP

CAPACITORS

Notes: 1. All capacitors are fixed, ceramic, and 500V unless otherwise specified; pf denotes picofarads.

2. GMV denotes Guaranteed Minimum Value.

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8001	0317 5100	mica, 20 pf	EMC	DM 15
C8002	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8003	0317 3840	330 pf, ±10%	EIA	
C8004	0326 9480	variable, air, 9-35 pf	ERC	Style 538
C8101	0326 9490	variable, air, 2-8 pf, 200V	ERC	Style 538
C8102	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8103	0315 2000	100 pf, ±20%	EIA	
C8104	0326 4520	1000 pf, GMV	ERC	
C8105	0315 3720	2200 pf, +100 −0%	ERC	
C8106	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8107	0326 8490	paper, 0.1 μf, ±20%, 200V	HOP	Part No. P12D
C8108 & C8109	0314 6860	5.6 pf, ±1%	EIA	
C8110	0317 5060	mica, 10 pf, ±5%	EMC	DM15
C8111	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8112	0316 9520	2200 pf, 1000V	RMC	JL
C8113	0315 3610	100 pf, ±10%	EIA	
C8114	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8115	0326 4520	1000 pf, GMV	ERC	
C8116	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8117	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8118	0316 0270	22 pf	EIA	
C8119	0326 9510	variable, air, 2.5-11 pf, 200V	ERC	
C8120	0315 3610	100 pf, ±10%	EIA	
C8121	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8122	0315 3610	100 pf, ±10%	EIA	
C8123	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8124	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8126	0305 5600	mica, 47 pf, ±10%	EIA	
C8127	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8128	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8129	0315 3610	100 pf, ±10%	EIA	
C8131	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8132	0316 4180	9.1 pf, 1000V	RMC	C
C8133	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8134	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8135	0317 3200	12 pf, ±10%	CRL	
C8136	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8137	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C8200	0326 4520	1000 pf, GMV	ERC	
C8201	0316 7200	4.7 pf, ±0.25 pf	ERC	NPO SI-1
C8202	0319 1060	0.01 μf +60 −40%, 150V	CRL	DDM
C8203	0315 2000	100 pf, ±20%	EIA	
C8204	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8205	0315 3720	2200 pf, +100 −0%	ERC	
C8206	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8208 & C8209	0314 6860	5.6 pf, ±1%	EIA	
C8211	0326 8490	paper, 0.1 μf, ±20%, 200V	HOP	No. P12D
C8213	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8214	0316 9520	2200 pf, 1000V	ERC	
C8216	0305 5600	mica, 47 pf, ±5%	EIA	
C8217	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8218	0317 5100	mica, 20 pf, ±5%	EMC	DM15
C8219	0315 3610	100 pf, ±10%	EIA	
C8221	0317 5100	mica, 20 pf	EMC	DM15
C8223	0305 5850	mica, 510 pf, ±10%, 300V	EIA	
C8224	0315 3610	100 pf, ±10%	EIA	
C8228	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8229	0316 4180	9.1 pf, ±5%, 1000V	RMC	C
C8231 & C8232	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8233	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8234	0315 1920	220 pf, ±20%	ERC	Style 331GP2
C8235	0317 3200	12 pf, ±10%	CRL	#TB60120 KCOG
C8241	0326 7620	electrolytic, 5 μf, 50V	SPG	"Littl-Lytic"
C8242	0313 3960	Cap, Comp, 10 pf		
C8243	0319 1050	Cap, Cer, 0.02 μf	CRL	DDM
C8300	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8301	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8302	0316 7200	4.7 pf, ±0.25 pf	ERC	NPO-331
C8305	0305 5600	mica, 47 pf, ±5%	EIA	
C8306 C8307 & C8309	0317 5090	mica, 18 pf, ±5%	EMC	DM15
C8312	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8313	0326 7880	plastic, 0.22 μf, ±10%, 200V	AMX	C296AB
C8314	0326 8080	plastic, 0.22 μf, ±10%, 400V	AMX	C296AB
C8315	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8316	0317 5210	mica, 51 pf, ±5%	EMC	DM15
C8317	0326 9480	variable, 9-35 pf, 100V	ERC	Style 538
C8318 & C8319	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8401 to C8403	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM Part No.
C8404	0326 8490	paper, 0.1 μf, ±20%, 200V	HOP	P12D
C8405	0327 1630	electrolytic, 2 μf, +100 −10%, 100V	SPG	Series TE "Littl-Lytic"
C8406	0326 8060	plastic, 0.1 μf, ±10%, 400V	AMX	C296AC
C8407	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8408	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8409	0317 6750	mica, 1000 pf, ±5%	EMC	DM20
C8411	0316 0330	39 pf	EIA	
C8412	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8414	0316 0330	39 pf	EIA	
C8416	0319 1060	0.01 μf, +60 −40%, 150V	CRL	DDM
C8441	0316 7280	10 pf, ±0.25 pf	ERC	NPO-331
C8442 & C8443	0326 4520	1000 pf, GMV	ERC	
C8446 & C8447	0326 4520	1000 pf, GMV	ERC	
C8449	0326 4520	1000 pf, GMV	ERC	
C8451	0326 4520	1000 pf, GMV	ERC	
C8501	0327 1580	mica, 348 pf, ±.5%	EMC	DM15
C8502	0327 1510	mica, 3831 pf, ±.5%	EMC	DM19
C8503	0327 2090	plastic, 0.03866 μf, ±.5%, 100V	GUD	336B
C8504	0316 0300	30 pf	EIA	
C8506	0326 9490	variable, air, 2-8 pf, 200V	ERC	Style 538
C8507	0327 8270	plastic, 0.86 μf, ±1%, 100V	GUD	F396-023A
C8508	0316 4180	9.1 pf, 1000V	RMC	C
C8509	0316 3790	27 pf, 1000V	RMC	C
C8510	0316 3850	47 pf, 1000V	RMC	C
C8551	0327 1580	mica, 348 pf, ±.5%	EMC	DM15
C8552	0327 1510	mica, 3831 pf, ±.5%	EMC	DM19
C8553	0327 2090	plastic, 0.03866 μf, ±.5% 100V	GUD	336B

Symbol	Part Number	Description	Recommended Vendor Code	Type
C8554	0316 0300	30 pf	EIA	
C8556	0326 9490	variable, air, 2-8 pf, 200V	ERC	Style 538
C8557	0327 8270	plastic, 0.86 μf, ±1%, 100V	GUD	F396-023A
C8558	0315 4660	4700, ±10%, 1000V	RMC	JL
C8559	0319 6250	plastic, 0.05 μf, ±10%, 150V	GUD	Series 338Y
C8560	0316 4180	9.1 pf, 1000V	RMC	C
C8561	0316 3790	27 pf, 1000V	RMC	C
C8562	0316 3850	47 pf, 1000V	RMC	C
C8563	0326 7930	plastic, 1 μf, ±10%, 125V	AMX	C296AB
C8601	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8602	0326 7860	plastic, 0.1 μf, ±10%, 200V	AMX	C296AB
C8604	0315 3720	2200 pf, +100 −0%	ERC	
C8606	0326 9480	variable, air, 9-35 pf, 100V	ERC	Style 538
C8607	0326 7630	electrolytic, 10 μf, +100 −10%, 50V	SPG	"Littl-Lytic"
C8608	0319 1060	0.01 μf, +60 −40%. 150V	CRL	DDM
C8609	0317 5210	mica, 51 pf, ±5%	EMC	DM15
C8611	0319 1050	0.02 μf, +60 −40%, 150V	CRL	DDM
C8701	0317 5110	mica, 22 pf, ±5%	EMC	DM15
C8702	0327 3420	electrolytic, 10 μf, −10 +75%	SPG	"Littl-Lytic"
		SEMICONDUCTORS		
CR8001	2600 6910	diode, FD841	FCI	
CR8101	2600 8150	diode, 1N3717	EIA	
CR8102 to				
CR8112	2600 6910	diode, FD841	FCI	
CR8113	2600 8020	diode, FDG3091	FCI	
CR8114	2600 6910	diode FD841	FCI	
CR8201	2600 8150	diode, 1N3717	EIA	
CR8202 to				
CR8205	2600 6910	diode, FD841	FCI	
CR8206 to				
CR8212	2600 6910	diode, FD841	FCI	
CR8214 &				
CR8215	2600 6910	diode, FD841	FCI	
CR8216	2600 8020	diode, FDG3091	FCI	
CR8217	2600 6930	diode, Si, FD300	FCI	
CR8218	2600 6820	diode, Si, FD281	FCI	
CR8219	2601 2320	diode, Si, FD360	FCI	
CR8401	2600 6820	diode, FD281	FCI	
CR8402	2600 6910	diode, FD841	FCI	
CR8403	2600 6820	diode, FD281	FCI	
CR8404	2600 6910	diode, FD841	FCI	
CR8406	2600 6910	diode FD841	FCI	
CR8407	2601 2320	diode Si, FD300	FCI	
CR8601	2600 9250	diode, TD-2A	GE	
CR8602 to				
CR8604	2600 6910	diode, FD841	FCI	
CR8701	2600 6910	diode, FD841	FCI	
		LAMPS		
DS8101	1200 3960	neon, 0.3 milliamperes, 1/25W (SWP READY)	GE	NE-2
DS8201 & DS8202	200 3960	neon, 0.3 milliamperes, 1/25W (UNCAL)	GE	NE-2
DS8301 & DS8302	1201 2350	neon (BEAM POS IND)	SIG	T2-27 IR100
E8101	1200 3960	glow, neon, NE-2	GE	NE-2
E8201	1200 3960	glow, neon, NE-2	GE	NE-2
		HYBRID & RF COILS		
HY8101, HY8302, HY8303 & HY8304	2110 1560	Bead, ferrite	FER	Part No. 56-590-65/3B
HY8603	2110 1560	Bead, ferrite	FER	Part No. 56-590-65/3B
L8101 & L8102	2110 1350	coil, rf, 3.3 μh, ±5%	SWW	D10647
L8301 & L8302	2110 1840	coil, rf. 150μh, ±5%	SWW	41,500
L8303	2110 2530	coil, rf. 1mh		
		ELECTRICAL CONNECTORS		
J8100 & J8200	0905 7610	receptacle, rf, BNC, female, 1 contact (EXT TRIG)		UG 625A/U
J8201	0905 6700	jack tip, banana type, insulated, black (SAW OUT)	JHN	108-903
J8401 & J8402	0905 6700	jack tip, banana type, insulated, black (GATE)	JHN	108-903
P8001	0905 7340	plug. male, 32 contacts	APH	26-159-32

Symbol	Part Number	Description	Recommended Vendor Code	Type
		TRANSISTORS		
Q8001	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8002	2631 2210	2N3723	FCI	
Q8101	2600 7420	DU #9A	FCI	
	2600 7400	alternate 2N869		
Q8102	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8103 & Q8104	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8106 & Q8107	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8108	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8202	2600 7420	DU #9A	FCI	
	2600 7400	alternate 2N869		
Q8203 & Q8204	2600 7150	DU #4A	FCI	
	2600 7150	alternate 2N1132		
Q8205	2600 7070	DU #2A	FCI	
	2600 7050	alternate 2N915		
Q8206 & Q8207	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8208	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8209	2601 0400	tstr, Si, MM3001		
Q8210	2600 7250	tstr, Si, 2N1893		
Q8301 to Q8303	2600 7080	DU #2B	FCI	
	2600 7050	alternate 2N915		
Q8304	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8305 & Q8306	2600 7080	DU #2B	FCI	
	2600 7050	alternate 2N915		
Q8307	2600 3061	DU #36A (Selected)	FCI	
	2600 8640	alternate DU #36A	FCI	
Q8308 & Q8309	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8311	2600 8640	DU #36A	FCI	
Q8401	2600 7180	DU #4B	FCI	
	2600 7150	alternate 2N1132		
Q8402	2600 7270	DU #6A	FCI	
	2600 7250	alternate 2N1893		
Q8403	2600 7370	DU #8A/2N699B	ABD/FCI	8A/2N699B
Q8404 to Q8406	2600 7020	DU #1A	FCI	
	2600 7000	alternate 2N914		
Q8601 & Q8602	2600 7070	DU #2A	FCI	
	2600 7050	alternate 2N915		
Q8603	2600 7260	DU #6	FCI	
	2600 7250	alternate 2N1893		
Q8604	2600 7010	DU #1	FCI	
	2600 7000	alternate 2N914		
Q8701 to Q8703	2600 8190	DU #14A	FCI	
	2600 8170	alternate 2N2369		

RESISTORS

Notes: 1) All resistors are fixed, film, ±5%, and ½W. Values are in ohms unless otherwise specified; K = thousand, M = million.

2) Listed below are the Part Numbers for fixed, film, resistors used on the TIME/DIV switches. These resistors are selected for plus or minus tolerances.

All minus tolerance units are marked with a yellow dot and plus tolerance units are marked with a green dot.

Resistor Part Number

0239 0241 to 0239 0249
0239 0251 to 0239 0259
0239 0261 to 0239 0279
0239 0281 to 0239 0299

When a replacement is ordered, a pair of resistors, one marked with a yellow dot and the other with a green dot will be sent. If a color-coded component is removed from the unit, be sure to replace it with the corresponding color dot component. This will insure proper performance of the plug-in module.

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8013	0234 8530	22K	CGW	C-20
R8017	0203 2010	composition, 100K, ±10%	ALB	EB
R8100	0109 0830	variable, composition, 100K, ±20%, .2W (TRIG BAL)	CTS	Series 70
R8101	0229 9050	111K, ±1%	TEX	CD1/2PR
R8102	0229 4910	900K, ±1%	TEX	CD1/2PR
R8103	0235 4850	composition, 10K, ¼W	ALB	CB
R8104	0203 0960	composition, 100K	ALB	EB
R8105	0109 0820	variable, composition, 500K, ±20%, .2W (DC BAL)	CTS	Series 70
R8106	0235 5170	composition, 220K, ¼W	ALB	CB
R8107	0235 5330	composition, 1M, ¼W	ALB	CB
R8108	0236 3150	360K	CGW	C-20
R8109	0234 8510	18K	CGW	C-20
R8110	0235 4910	composition, 18K, ¼W	ALB	CB
R8111F/R	0107 2791	variable, composition, 500K/10K, ±20% (TRIG LEVEL X AMP)	ABD	
R8112	0234 8510	18K	CGW	C-20
R8113	0234 8460	11K	CGW	C-20
R8114	0234 7970	100	CGW	C-20
R8115	0236 6700	11.5K, ±1%	CGW	N20
R8116	0235 4410	composition, 130, ¼W	ALB	CB
R8117	0234 7910	56	CGW	C-20
R8118	0107 5900	variable, composition, 100, ±20% (TRIG SENS)	CTS	65
R8119	0203 0110	composition, 30	ALB	EB
R8120	0236 6700	11.5K, ±1%	CGW	N20
R8121	0234 8600	43K	CGW	C-20
R8122	0234 8280	2K	CGW	C-20
R8123	0234 7970	100	CGW	C-20
R8124	0235 4410	composition, 130, ¼W	ALB	CB
R8125	0236 7210	39.2K, ±1%	CGW	N20
R8126	0236 7050	26.7K	CGW	NS-20
R8127	0203 1730	composition, 470, ±10%	ALB	EB
R8128	0236 7100	30.1K	CGW	NS-20
R8129	0203 2090	composition, 470K, ±10%	ALB	EB
R8130	0236 7020	24.9K, ±1%	CGW	N20
R8131	0203 2090	composition, 470K, ±10%	ALB	EB
R8132	0234 8080	300	CGW	C-20
R8133	0235 9240	1.1K, ±1%	CGW	NI-20
R8134	0234 9190	3.9K, 1W	CGW	C-32
R8135	0234 8610	47K	CGW	C-20
R8136 & R8137	0203 1910	composition, 15K, ±10%	ALB	EB
R8138	0235 9240	1.1K, ±1%	CGW	NI-20
R8139	0236 3100	220K	CGW	C-20
R8140	0234 8110	390	CGW	C-20
R8141 & R8142	0203 1170	composition, 750K	ALB	EB
R8143	0234 8640	62K	CGW	C-20
R8144	0234 8450	10K	CGW	C-20
R8145 & R8146	0234 8610	47K	CGW	C-20
R8147	0234 8110	390	CGW	C-20
R8148	0234 8010	150	CGW	C-20
R8149	0234 6160	750, ±1%, 2W	CGW	SI-25
R8150	0234 8440	9.1K	CGW	C-20
R8151	0228 7130	953, ±1%, 1W	CGW	SI-20
R8152	0203 1170	composition, 750K	ALB	EB
R8153	0234 8480	13K	CGW	C-20
R8154	0235 9600	2.49K, ±1%, 1W	CGW	NI-20
R8155	0239 1192	1K, ±1%, 1W	CGW	SI-20
R8156	0203 2010	composition, 100K, ±10%	ALB	EB
R8157 & R8158	0234 8450	10K	CGW	C-20
R8159	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	Series 70
R8160	0203 1940	composition, 27K, ±10%	ALB	EB
R8161	0234 9220	5.1K, 1W	CGW	C-32
R8162	0234 8270	1.8K	CGW	C-20
R8163	0203 1650	composition, 100, ±10%	ALB	EB
R8164	0234 8320	3K	CGW	C-20
R8165	0234 8590	39K	CGW	C-20
R8166	0236 0420	14K, ±1%	CGW	NI-20
R8167	0234 7970	100	CGW	C-20
R8168	0234 8450	10K	CGW	C-20
R8169	0234 8140	510	CGW	C-20
R8170	0203 2010	composition, 100K	ALB	EB
R8171	0234 9450	47K, 1W	CGW	C-32
R8172	0234 7970	100	CGW	C-20
R8173	0203 2070	composition, 330K, ±10%	ALB	EB
R8174	0234 8690	100K	CGW	C-20
R8175	0109 0810	variable, composition, 250, ±20%, .3W (SWP RATE BAL)	CTS	Series 70
R8176 & R8177	0234 7970	100	CGW	C-20
R8178	0239 1392	6.8K, 2W	CGW	C-42
R8179	0203 0160	composition, 47	ALB	EB
R8180	0234 8560	30K	CGW	C-20
R8181	0234 8280	2K	CGW	C-20
R8182	0236 7190	37.4K, ±1%	CGW	NS-20
R8183	0235 4450	composition, 200, ¼W	ALB	CB
R8184	0234 8380	5.1K	CGW	C5
R8200	0234 7970	100	CGW	C-20
R8201	0204 0970	composition, 110K	IRC	GBT1/2
R8202	0204 1190	composition, 910K	IRC	GBT1/2
R8203	0235 4850	composition, 10K, ¼W	ALB	CB
R8204	0203 0960	composition, 100K	ALB	EB
R8206	0235 5170	composition, 220K, ¼W	ALB	CB
R8207	0235 5400	composition, 1M, ¼W	ALB	CB
R8208	0236 3100	220K	CGW	C-20
R8217	0234 7970	100	CGW	C-20
R8218	0235 4410	composition, 130, ¼W	ALB	CB
R8219	0235 4380	composition, 100, ¼W	ALB	EB
R8221	0234 8580	36K	CGW	C-20
R8222	0107 3581	variable, composition, 500K, ±20% (TRIG LEVEL)	ABD	
R8223	0234 8580	36K	CGW	C-20
R8224	0234 8600	43K	CGW	C-20
R8226	0234 7970	100	CGW	C-20
R8227	0235 4410	composition, 130, ¼W	ALB	CB
R8228	0203 0150	composition, 43	ALB	EB
R8229	0107 5900	variable, composition, 100, ±20% (TRIG SENS)	CTS	65
R8231	0203 0110	composition, 30	ALB	EB
R8232	0234 8600	43K	CGW	C-20
R8233	0236 2880	wire wound, 5.8K, ±1%, 2W	DAL	RS2A
R8234	0109 0830	variable, composition, 100K, ±20%, .2W (TRIG BAL)	CTS	Series 70
R8238	0236 7050	26.7K	CGW	NS-20
R8239	0203 1730	composition, 470, ±10%	ALB	EB
R8240	0236 7100	30.1K	CGW	NS-20
R8241F/R	0107 2701	variable, wire wound, 2.5K/ 10K, 2W (SWP CAL)	ABD	
R8242 (part of S851)	0107 2711	variable, wire wound, 2.5K, ±10%, 2W (SWP VERNIER)	ABD	
R8243	0236 3190	wire wound, 1.2K, ±10%, 1W	CGW	C-20
R8244	0234 8690	100K	CGW	C-20
R8245	0203 1030	composition, 200K	ALB	EB
R8246	0234 8690	100K	CGW	C-20
R8247	0234 8450	10K	CGW	C-20
R8248	0203 2130	composition, 1M, ±10%	ALB	EB
R8249	0234 8030	180	CGW	C-20
R8250	0234 8450	10K	CGW	C-20
R8251	0234 6160	750, ±1%, 2W	CGW	SI-25
R8252	0228 7130	953, ±1%, 1W	CGW	SI-20
R8253	0234 8440	9.1K	CGW	C-20
R8254	0203 1170	composition, 750K	ALB	EB
R8255	0203 1940	composition, 27K, ±10%	ALB	EB
R8256	0239 1192	1K, ±1%, 1W	CGW	SI-20
R8257	0235 9600	2.49K, ±1%	CGW	NI-20
R8258	0234 8480	13K	CGW	C-20
R8259	0203 2010	composition, 100K, ±10%	ALB	EB
R8260	0234 8450	10K	CGW	C-20
R8261	0234 8600	43K	CGW	C-20
R8262	0234 9220	5.1K, 1W	CGW	C-32
R8263	0109 0800	variable, composition, 1.5K, ±20%, .3W (SWP LENGTH)	CTS	Series 70
R8264	0234 8270	1.8K	CGW	C-20
R8265	0236 5100	247, ±1%	CGW	N-20
R8266	0236 0420	14K, ±1%	CGW	NI-20
R8267	0234 9230	5.6K, 1W	CGW	C-32
R8269	0234 7970	100	CGW	C-20

section 6a — parts list and schematics

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8270	0234 8590	39K	CGW	C-20
R8271	0234 8320	3K	CGW	C-20
R8272	0234 8450	10K	CGW	C-20
R8273	0234 8140	510	CGW	C-20
R8275	0234 8450	10K	CGW	C-20
R8276	0203 2070	composition, 330K, ±10%	ALB	EB
R8278	0234 9450	47K, 1W	CGW	C-32
R8279	0234 7970	100	CGW	C-20
R8280	0203 0830	composition, 30K	ALB	EB
R8281	0234 8690	100K	CGW	C-20
R8282 & R8283	0234 7970	100	CGW	C-20
R8284	0234 8280	2K	CGW	C-20
R8285	0234 8380	composition, 5.1K	CGW	C-20
R8286	0239 1392	6.8K, 2W	CGW	C-42
R8287	0203 0160	composition, 47	ALB	EB
R8288	0235 4850	res, fxd, comp, 10K		
R8289	0235 5250	res, fxd, comp, 470K		
R8290	0234 8370	res, fxd, 4.7K		
R8291	0235 5570	res, fxd, comp, 10M		
R8292	0236 6550	res, fxd, MF, 8.06K, 1%		
R8293	0236 6290	res, fxd, MF, 4.32K, 1%		
R8294	0234 8620	res, fxd, 51K		
R8295	0234 9400	res, fxd, 30K, 1W		
R8296	0203 0660	res, fxd, comp, 5.6K		
R8301	0228 5110	13.3K, ±1%	IRC	DCC
R8302	0203 1030	200K	ALB	EB
R8303	0234 8690	100K	CGW	C-20
R8306 (part of S840)	0107 2912	variable, 30K, ±10%, ¾W (POSITION)	ABD	
R8307	0107 2545	variable, composition, 50K, ±20%	ABD	
R8308	0234 8000	130	CGW	C-20
R8309	0234 8430	8.2K	CGW	C-20
R8310	0203 1130	composition, 510K	ALB	EB
R8311	0109 0710	variable, composition, 750, ±10% (X10 REG)		Series 65
R8312	0234 8470	12K	CGW	C-20
R8313	0236 0270	10K, ±1%	CGW	NI-20
R8314	0235 8710	365, ±1%	CGW	NI-20
R8315	0235 0310	composition, 91, ±1%	CGW	C5
R8316	0109 3600	variable, composition, 1K, 0.1W (X10 CAL)	CRL	601-1
R8317	0236 6720	12.1K, ±1%	CGW	N20
R8318	0203 0160	composition, 47	ALB	EB
R8319	0235 4380	composition, 100, ¼W	ALB	CB
R8320	0203 0900	composition, 56K	ALB	EB
R8321	0236 6720	12.1K, ±1%	CGW	N20
R8322	0228 5040	1.21K, ±1%	IRC	DCC
R8323 & R8324	0236 6530	7.68K, ±1%	CGW	C5
R8325	0228 5190	62K, ±1%	IRC	DCC
R8326	0228 5040	1.21K, ±1%	IRC	DCC
R8327	0235 9690	3.01K, ±1%	CGW	NI-20
R8328	0235 9600	2.49K, ±1%	CGW	C5
R8329	0236 5630	887, ±1%	CGW	N20
R8331 & R8332	0235 4380	100, ¼W	ALB	CB
R8333	0234 8250	1.5K	CGW	C-20
R8334	0234 9160	3K, 1W	CGW	C-32
R8336	0234 9160	3K, 1W	CGW	C-32
R8337	0203 0070	composition, 20	ALB	EB
R8338	0235 4260	composition, 33, ¼W	ALB	CB
R8339	0109 0700	variable, composition, 750, ±10% (X10 REG)	CTS	Series 65
R8340	0235 1760	7.8K, 5W	CGW	LPI-5
R8341	0235 4260	composition, 33, ¼W	ALB	CB
R8342	0235 1760	7.8K, 5W	CGW	LPI-5
R8343 & R8344	0235 1750	2.1K, 5W	CGW	LPI-5
R8345 & R8346	0235 1760	7.8K, 5W	CGW	LPI-5
R8347	0236 5680	1K, ±1%	CGW	NS-20
R8348	0235 4380	composition, 100, ¼W	ALB	CB
R8349	0235 5150	180K, ¼W	ALB	CB
R8350	0203 0110	composition, 30	ALB	EB
R8351	0235 5150	180K, ¼W	ALB	CB
R8352 & R8353	0235 4380	composition, 100, ¼W	ALB	CB
R8355 & R8356	0203 1890	composition, 10K, ±10%	ALB	EB
R8357	0234 8590	39K	CGW	C-20
R8400	0203 0740	composition, 12K	ALB	EB
R8401	0234 8080	300	CGW	C-20
R8402	0236 0450	15K, ±1%	CGW	NI-20
R8403	0235 9850	4.32K, ±1%	CGW	NI-20
R8404	0234 8210	1K	CGW	C-20
R8406	0234 5120	wire wound, 3.6K, 3W	DAL	CS-2B
R8407	0234 7970	10Ω	CGW	C-20
R8408	0236 2800	wire wound, 10K, 2W	DAL	CS-2A
R8409	0203 0100	composition, 27	ALB	EB
R8410	0234 8040	200	CGW	C-20
R8411	0234 0950	wire wound, 6K, 5W	WSL	5X
R8412	0236 0100	7.5K, ±1%	CGW	C-20
R8413	0235 9750	3.4K, ±1%	CGW	NI-20
R8414	0203 1080	composition, 330K	ALB	EB
R8415	0203 0740	composition, 12K	ALB	EB
R8416	0228 7120	499, ±1%, 1W	CGW	SI-20
R8417	0234 8410	6.8K	CGW	C-20
R8418	0203 1090	composition, 360K	ALB	EB
R8419	0234 8290	2.2K	CGW	C-20
R8420	0203 1050	composition, 240K	ALB	EB
R8421	0203 0000	composition, 10	ALB	EB
R8422	0234 8140	510	CGW	C-20
R8423	0203 0890	composition, 51K	ALB	EB
R8424	0236 3150	360K	CGW	C-20
R8425	0203 0830	composition, 30K	ALB	EB
R8426	0234 8410	6.8K	CGW	C-20
R8427	0234 8290	2.2K	CGW	C-20
R8428	0234 8140	510	CGW	C-20
R8429	0236 7310	49.9K, ±1%	CGW	N20
R8430	0203 1770	composition, 1K, ±10%	ALB	EB
R8440	0203 0000	composition, 10	ALB	EB
R8441	0239 1359	430, 2W	CGW	C-42
R8442	0236 0690	24.9K, ±1%	CGW	NI-20
R8443	0235 9600	2.49K, ±1%	CGW	NI-20
R8444	0239 1359	430, 2W	CGW	C-20
R8445	0234 8190	820	CGW	C-20
R8446	0234 8210	1K	CGW	C-20
R8501	0239 0288	1.2M, ±.5%	ABD	
R8502	0239 0291	2M, ±.5%	ABD	
R8503	0239 0292	4M, ±.5%	ABD	
R8504	0239 0285	400K, ±.5%	ABD	
R8506	0239 0284	200K, ±.5%	ABD	
R8507	0239 0283	120K, ±.5%	ABD	
R8508	0239 0282	40K, ±.5%	ABD	
R8509 & R8510	0239 0281	20K, ±.5%	ABD	
R8511	0239 0251	18M, ±1%, 1W	ABD	
R8512	0239 0241	9M, ±1%	ABD	
R8513	0239 0242	5.4M, ±1%	ABD	
R8514	0239 0289	1.8M, ±.5%	ABD	
R8516	0239 0287	900K, ±.5%	ABD	
R8517	0239 0286	500K, ±.5%	ABD	
R8551	0239 0288	1.2M, ±.5%	ABD	
R8552	0239 0291	2M, ±.5%	ABD	
R8553	0239 0292	4M, ±.5%	ABD	
R8554	0239 0285	400K, ±.5%	ABD	
R2556	0239 0284	200K, ±.5%	ABD	
R8557	0239 0283	120K, ±.5%	ABD	
R8558	0239 0282	40K, ±.5%	ABD	
R8559 & R8560	0239 0281	20K, ±.5%	ABD	
R8561	0239 0251	18M, ±1%, 1W	ABD	
R8562	0239 0241	9M, ±1%	ABD	
R8563	0239 0242	5.4M, ±1%	ABD	
R8564	0239 0289	1.8M, ±.5%	ABD	
R8566	0239 0287	900K, ±.5%	ABD	
R8567	0239 0286	500K, ±.5%	ABD	
R8601	0203 0110	composition, 30	ALB	EB
R8602	0203 0310	composition, 200	ALB	EB
R8603	0235 4780	composition, 5.1K, ¼W	ALB	CB
R8604	0235 4380	composition, 100, ¼W	ALB	CB
R8605	0235 4780	composition, 5.1K, ¼W	ALB	CB
R8607	0234 8690	100K	CGW	C-20
R8608	0234 7510	18K	CGW	C-20
R8609	0234 8530	22K	CGW	C-20
R8611	0203 0160	composition, 47	ALB	EB
R8612	0235 4380	composition, 100, ¼W	ALB	CB
R8613	0234 8690	100K	CGW	C-20
R8614	0109 0460	variable, wire wound, 4K, ±10%, 1.5W (DLY CAL ADJ)	CLS	49M
R8615	0203 2130	composition, 1M, ±10%	ALB	EB
R8616	0234 5150	wire wound, 9.1K, 3W	DAL	CS-2B
R8617	0109 0920	variable, wire wound, 2K, 2W (DELAY VERNIER)	CLS	Series 62JA

Symbol	Part Number	Description	Recommended Vendor Code	Type
R8618	0109 0490	variable, composition, 250, ±20%, .3W (DELAY ZERO)	CTS	Series 70
R8619	0239 1378	2.2K, 2W	CGW	C-42
R8620	0235 4380	composition, 100, ¼W	ALB	CB
R8621	0234 8470	12K	CGW	C-20
R8622	0234 8490	15K	CGW	C-20
R8623	0236 7190	37.4K, ±1%	CGW	NS-20
R8701	0234 8710	120K	CGW	C-20
R8702	0234 8560	30K	CGW	C-20
R8703	0234 8280	2K	CGW	C-20
R8704	0236 3120	270K	CGW	C-20
R8705	0234 8350	3.9K	CGW	C-20
R8706	0236 7010	24.3K, ±1%	CGW	NS-20
R8707	0234 8300	2.4K	CGW	C-20
R8708	0236 7130	32.4K, ±1%	CGW	NS-20

SWITCHES

Symbol	Part Number	Description	Recommended Vendor Code	Type
S810 & S811	0503 2570	slide, DP3T (S810 — SOURCE) (S811 — COUPLING)	STC	SS-54
S812	0503 2580	slide, DPDT (SLOPE)	STC	SS-54
S813 (Part of R8111 (F/R)	0107 2791	push-pull, 1 ampere, 125V, SPDT (PULL EXT 1/10)	STC	
S820 & S821	0503 2570	slide, DP3T (S820 — SOURCE) (S821 — COUPLING)	STC	SS-54
S822	0503 2580	slide, DPDT (SLOPE)	STC	SS-50
S823 (part of R8222)	0107 2393	push-pull, 1 ampere, 125V, SPDT (PULL EXT 1/10)	STC	
S824	0503 2700	toggle, DP3T, 5 amperes at 115V ac	ALCO	MST-205N
S825	0503 2830	switch, toggle, DP3T, ON, ON, (ON)		
S830 (part of R8307)	0107 2545	slide, DPDT (PULL X10 MAG)	ABD	
S840	0501 7123	rotary. 3 sections, 6 positions, 60° (DISPLAY LOGIC)	ABD	
S850	0501 7691	rotary (TIME/DIV)	ABD	
S851 (part of R8242)	0107 2711	rotary, linear, SPDT, 3 amperes, 125V	ABD	

TRANSFORMERS

Symbol	Part Number	Description	Recommended Vendor Code	Type
T8101	2001 4921	pulse	ABD	
T8201	2001 4922	pulse	ABD	
T8601	2001 4922	pulse	ABD	

ELECTRON TUBES

Symbol	Part Number	Description	Recommended Vendor Code	Type
V8101 & V8102	2501 3430	7586	RCA	Nuvistor
V8103	2501 3450	7587	RCA	Nuvistor
V8104	2501 3430	7586	RCA	Nuvistor
V8201 & V8202	2501 3430	7586	RCA	Nuvistor
V8203	2501 3450	7587	RCA	Nuvistor
V8204	2501 3430	7586	RCA	Nuvistor

NETWORK

Symbol	Part Number	Description	Recommended Vendor Code	Type
Z8601	8800 2336	peaking	ABD	

NOTES

SECTION 6B
SPARE PARTS LIST

SPARE PARTS REQUIREMENTS

a. General

The Type 74-13A Calibrated Delaying Sweep Plug-In is an extremely reliable and dependable instrument. Only components thoroughly tested and approved by the engineers of the Quality Assurance Laboratory are used in this instrument. Continued performance tests, environmental and life testing of production units make certain your oscilloscope will give many years of satisfactory service. These new Dumont oscilloscopes are precision engineered and require no selected parts.

Two lists of "running spares" are included to aid you in periodic maintenance. The running-spare parts lists include recommended quantities and reference symbol numbers. Section 6A of this Instruction Manual gives a complete listing of all components and their recommended vendors so that you may readily procure them from a local supply house or your own stores.

Note: The local Dumont Field engineering representative and his service organization can assist you in obtaining any additional components in the shortest possible time. To help expedite service, always give the Type Number and Serial Number of the instrument; always specify the part number and give a description of the component (see Section 6A of this manual).

b. 500-Hour Spares (6 months)

The recommended list for one through three units follows.

Electron Tubes

Symbol	Quantity
V8101	3
V8103	1

Transistors

Q8001	2
Q8002	1
Q8101	1
Q8102	2
Q8107	1
Q8201	1
Q8301	2
Q8307	1
Q8308	1
Q8401	1
Q8402	1
Q8601	1
Q8604	1

Diodes

Symbol	Quantity
CR8001	13
CR8101	1
CR8113	1
CR8213	1
CR8401	1
CR8601	1

Lamps

DS8101	1
DS8301	1

c. 2000-Hour Spares (2 years)

The recommended list for one through five units is given below. Maintain spares indicated plus one for each oscilloscope in use; 2 of each set of the 500-hour spare list given in paragraph (b) plus the quantities listed as follows:

Capacitors

Symbol	Quantity	Symbol	Quantity
C8001	2	C8219	1
C8002	1	C8231	1
C8003	1	C8234	1
C8004	1	C8300	1
C8101	1	C8302	1
C8102	1	C8305	1
C8103	1	C8309	1
C8104	1	C8311	1
C8105	1	C8314	1
C8106	1	C8316	1
C8107	1	C8317	1
C8108	1	C8318	1
C8111	8	C8405	1
C8112	1	C8406	1
C8113	3	C8409	1
C8115	3	C8416	1
C8116	1	C8441	1
C8118	1	C8501	1
C8120	1	C8502	1
C8126	1	C8503	1
C8129	1	C8504	1
C8131	4	C8506	1
C8132	1	C8507	1
C8134	1	C8508	1
C8135	1	C8509	1
C8137	1	C8510	1
C8201	1	C8558	1
C8207	1	C8559	1
		C8563	1
		C8607	1

Lamps

Symbol	Quantity
DS8101	1
DS8301	1

Electrical Connectors

J8100	1
J8401	1
P8001	1

Resistors

Symbol	Quantity	Symbol	Quantity
R8001	1	R8224	1
R8002	1	R8233	1
R8003	2	R8241	1
R8004	1	R8242	1
R8005	1	R8243	1
R8006	1	R8244	1
R8007	1	R8245	2
R8008	1	R8249	1
R8009	5	R8255	1
R8011	1	R8261	1
R8012	1	R8265	1
R8013	1	R8267	1
R8100	1	R8268	1
R8101	1	R8275	1
R8102	1	R8280	1
R8103	1	R8301	1
R8104	1	R8306	1
R8105	1	R8307	1
R8106	1	R8308	1
R8107	1	R8309	1
R8108	1	R8310	1
R8110	1	R8311	1
R8111	1	R8312	1
R8113	1	R8313	1
R8114	2	R8314	1
R8115	1	R8316	1
R8116	2	R8317	1
R8117	1	R8320	1
R8118	1	R8322	1
R8119	1	R8323	1
R8121	1	R8325	1
R8122	1	R8327	1
R8125	1	R8328	1
R8126	1	R8329	1
R8127	1	R8333	1
R8128	1	R8334	1
R8129	1	R8337	1
R8130	1	R8338	1
R8132	1	R8339	1
R8133	1	R8340	2
R8134	1	R8343	1
R8135	1	R8347	1
R8136	1	R8348	1
R8140	1	R8349	1
R8141	1	R8355	1
R8143	1	R8402	1
R8144	4	R8403	1
R8148	1	R8404	1
R8149	1	R8406	1
R8150	1	R8408	1
R8151	1	R8409	1
R8153	1	R8410	1
R8154	1	R8411	1
R8155	1	R8412	1
R8159	1	R8413	1
R8160	1	R8414	1
R8161	1	R8415	1
R8162	1	R8416	1
R8163	1	R8417	1
R8164	1	R8418	1
R8166	1	R8419	1
R8169	2	R8421	1
R8171	1	R8429	1
R8173	1	R8441	1
R8174	4	R8442	1
R8178	1	R8445	1
R8179	2	R8501	1
R8181	1	R8502	1
R8182	1	R8503	1
R8200	1	R8504	1
R8201	1	R8506	1
R8202	1	R8507	1
R8207	1	R8508	1
R8208	1	R8509	2
R8221	1	R8511	1
R8222	1	R8512	1

Symbol	Quantity	Symbol	Quantity
R8513	1	R8618	1
R8514	1	R8619	1
R8516	1	R8622	1
R8517	1	R8701	1
R8602	1	R8702	1
R8608	1	R8703	1
R8609	1	R8704	1
R8614	1	R8705	1
R8616	1	R8706	1
R8617	1	R8708	1

Transformers

Symbol	Quantity
T8101	1
T8601	1

Switches

Stock only one of each of the following switches for each 3 units being maintained:

S810, S811, S812, S813, S820, S821, S822, S823, S824, S830, S840, S850, S851

Note: Should a particular switch receive more than normal use in certain applications, then the quantity stocked of that particular switch should be doubled.

d. Miscellaneous

The following items may be stocked in quantities of one for each 2 units being maintained:

Name	Part Number
Bushing, shaft	4301 0933
Bushing	4301 3581
Microdial	4501 0430
Knob, fastener	4501 0431
Knob, small #1	4501 2452
Knob, knurled ground post	4501 2191
Knob, skirt	4501 2241
Knob, die case	4501 2261
Knob, small #2	4501 2271
Knob, small #1	4501 2302
Knob, medium	4501 2311
Ferrite Beads HY8101, HY8303 & HY8304	2110 1560
Coil, rf, L8101	2110 1350
Panel, front	3201 3143

e. Summary

The quantities of spare parts given in the preceding paragraphs are intended for industrial and military duty under normal environment and heavy-use conditions. It is suggested that the maintenance engineer evaluate:

1. The conditions under which the instruments will be used.
2. The skill of the maintenance technicians.
3. Other similar items on hand.
4. The effect of procurement time of spares and effects of instrument down-time on your organization.

It is recommended that inventories of spare parts outlined above be adjusted according to the requirements of your own laboratory or plant.

In the first analysis, the factory recommends the availability of spares or standby equipments since extensive life testing of your instrument has shown no higher failure rate for any specific component.

LIST OF RECOMMENDED VENDORS

CODE	NAME
ABD	Du Mont Laboratories
AER	Aerovox Corporation
AHH	Arrow-Hart & Hegeman Electric Company
ALB	Allen-Bradley Company
ALC	Allied Control
ALCO	Alco Electronic Products
ALD	Alden Products Company
AMA	Amaton Electronic Hardware
AMP	Amp Inc.
AMR	Amperite Company, Inc.
AMX	Amperex Electronics Products, Inc.
APC	American Phenolic Corporation
APH	Amphenol Electronics Corporation
ARC	Arco Electronics Inc. (Elmenco)
AST	Astron Corporation
AUT	Automatic Metal Products Corporation
BEL	Belfuse
BNS	Bourns Inc.
BUR	Burndy Engrg. Company
BUS	Bussmann Mfg. Company
CAN	Cannon Electric Company
CBS	CBS-Hytron Division of CBS
CDE	Cornell-Dubilier Electric Corporation
CGW	Corning Glass Works
CH	Cutler-Hammer, Inc.
CHC	Chester Cable Corporation
CHM	Chatham Electronics
CIN	Cinch Manufacturing Company
CLS	Clarostat Mfg. Co., Inc.
COC	Continental Carbon
COM	Comar Electric
COW	Continental-Wirt Electronics Corporation
CPC	C. P. Clare & Company
CRL	Centralab, Division of Globe-Union, Inc.
CST	Chicago Standard Transformer Corporation
CTC	Cambridge Thermionic Corporation
CTS	Chicago Telephone Supply Corporation
DAG	Dage Electric Company, Inc.
DAL	Dale Products, Inc.
DLC	Dialight Corporation
DRK	Drake Mfg. Company
EBY	Hugh H. Eby, Inc.
EDL	Edal Industries
EIA	Any manufacturer meeting EIA standards
ELC	Electra Manufacturing Company
ELD	Eldema Corporation
EMC	Electro Motive Mfg. Company
EMW	Elmwood Sensors, Inc.
ERC	Erie Resistor Corporation
ESX	Essex Electronics
FAST	John E. Fast Company
FCI	Fairchild Camera and Instrument Corporation
FER	Ferroxcube Corporation of America
GDE	Good-All Electric Mfg. Company
GE	General Electric Company
GEN	General Instrument Corporation
GEP	General Products Corporation
GLB	Globe Industries
GRC	General Radio Company
GRY	Grayhill, Inc.
GUD	The Gudeman Company
HAM	The Hammarlund Manufacturing Co., Inc.

CODE	NAME
HON	Honeywell
HOP	Hopkins Engineering Company
HP	Hewlett-Packard Company
IEC	International Electronics Corporation
IRC	International Resistance Company
IRP	International Rectifier Corporation
ITT	ITT Components Division
JEF	Jeffers Electronics, Inc.
JHN	E. F. Johnson Company
JWM	J. W. Miller Company
KUL	Kulka Electric Mfg. Co. Inc.
KXM	Klixon Metals and Control Corporation
LED	Ledex Inc.
LEE	Leecraft Mfg. Company
LFI	Littlefuse, Inc.
LIN	Line Electric
MAL	P. R. Mallory & Company, Inc.
MCR	Micro Switch (Division of Minneapolis-Honeywell Regulator Co.)
MIC	Micamold Electronics Mfg. Corporation
MIL	Miller Electric Company
MOT	Motorola Semiconductor Products, Inc.
MOV	M-O Valve Company Ltd.
MUC	Mucon Corporation
MUT	The Muter Company
NYT	New York Transformer Company, Inc.
OAK	Oak Mfg. Company
PHC	Philco Corporation
PHI	Philips Electronic Tube Division
PLS	Plastoid Corporation
POT	Potter & Brumfield, Inc.
PRC	Precision Resistor Co., Inc.
PYR	Pyramid Electric Company
RCA	Radio Corporation of America
RMC	Radio Materials Corporation
ROY	Royal Electric Corporation, Inc.
RTN	Rotron Mfg. Company
SIG	Signalite Inc.
SIL	Silicon Transistor Corporation
SLT	Sealectro Corporation
SOL	Solitron Devices, Inc.
SPG	Sprague Electric Company
STC	Stackpole Carbon Company
STW	Standard Winding Company
SUM	Summit Coil Company
SWW	Stanwyck Winding Company
SYL	Sylvania Electric Products, Inc.
SYN	Syntronic Instruments, Inc.
TEC	Transistor Electronics Corporation
TEX	Texas Instruments, Inc.
THC	Thermal Control, Inc.
TOR	Torrington Mfg., Company
TRS	Tresco, Inc.
TRU	Tru-Ohm Products
TUG	Tung-Sol Electric Inc.
UCN	Ucinite Company
UTC	United Transformer Company
VIC	The Victoreen Instrument Company
WDE	Wood Electric Corporation
WDL	Ward Leonard Electric Company
WES	Weston Electrical Instrument Corporation
WYN	Welwyn International Inc.

INSTRUMENT WARRANTY AND SERVICE NOTICE

WARRANTY

Dumont Oscilloscope Laboratories warrants that each new Cathode-ray Oscilloscope, Automotive Test Equipment, and other Electronic or Electrical Test or Measuring Equipment (hereinafter referred to as "Instrument") manufactured or sold by it, is free from defects in material or workmanship under normal use and service for a period of one year from the date of its sale to the first purchaser for use. If, upon examination by Dumont, the Instrument is determined to be defective in workmanship or material, Dumont will, subject to the conditions set forth below, either repair the defective part or replace it with a new part. Dumont shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall Dumont be liable for damages by reason of the failure of the Instrument to perform properly or for any consequential damages. This warranty does not apply to any Instrument that has been subject to negligence, accident, misuse or improper installation or operation or that in any way has been tampered with, altered or repaired by any person other than an authorized Dumont service organization or an employee thereof, or to any Instrument whose serial number has been altered, defaced or removed, or to any Instrument purchased within, and thereafter removed beyond the continental limits of the United States.

This warranty shall, at Dumont's option, become void unless registration thereof is promptly effected as provided below. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of Dumont or impose any obligation upon it in connection with the sale of any Instrument, other than as stated above.

REGISTERING THE WARRANTY

To register this warranty, the enclosed warranty registration card must be properly filled out and mailed to Dumont Oscilloscope Laboratories Service Department immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD. Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure service under our warranty, the enclosed warranty service card must be properly filled out and returned to the factory. In all cases where service or adjustment is requested, please first contact the factory or authorized depot, giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing to the factory in this respect, address:

Dumont Oscilloscope Laboratories, Incorporated
40 Fairfield Place, West Caldwell, New Jersey

The Service Department will then send to the customer the written procedure for disposition and shipping instructions. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

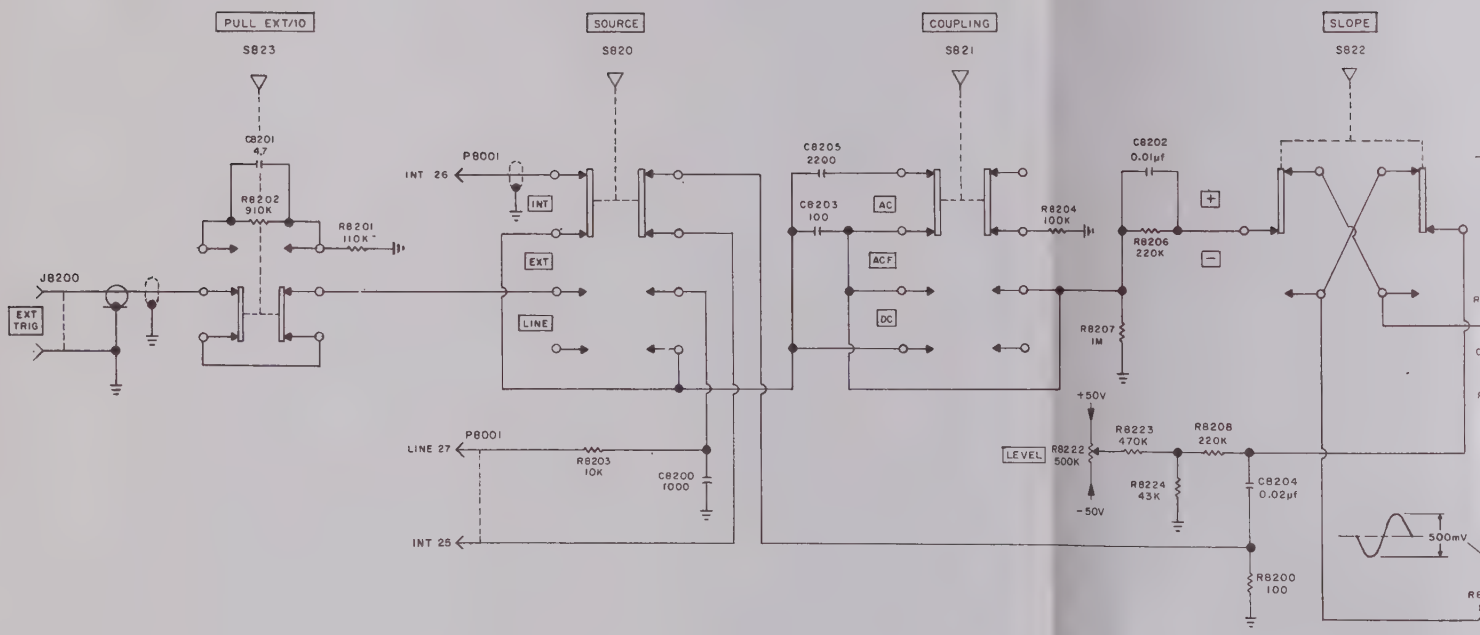
REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the Type number and Serial number of the Instrument. Before ordering parts for in-warranty replacement or purchasing them for out-of-warranty replacement, be sure to consult the Parts List in the Instruction Manual. The Parts List gives the values, tolerances, ratings, and Dumont part number for all electrical components used in the Instrument. This will help to expedite service.

PATENT NOTICE

Manufactured under one or more U. S. Patents owned or controlled by Dumont Oscilloscope Laboratories, Incorporated, 40 Fairfield Place, West Caldwell, New Jersey, U.S.A. Patent Numbers supplied upon request.

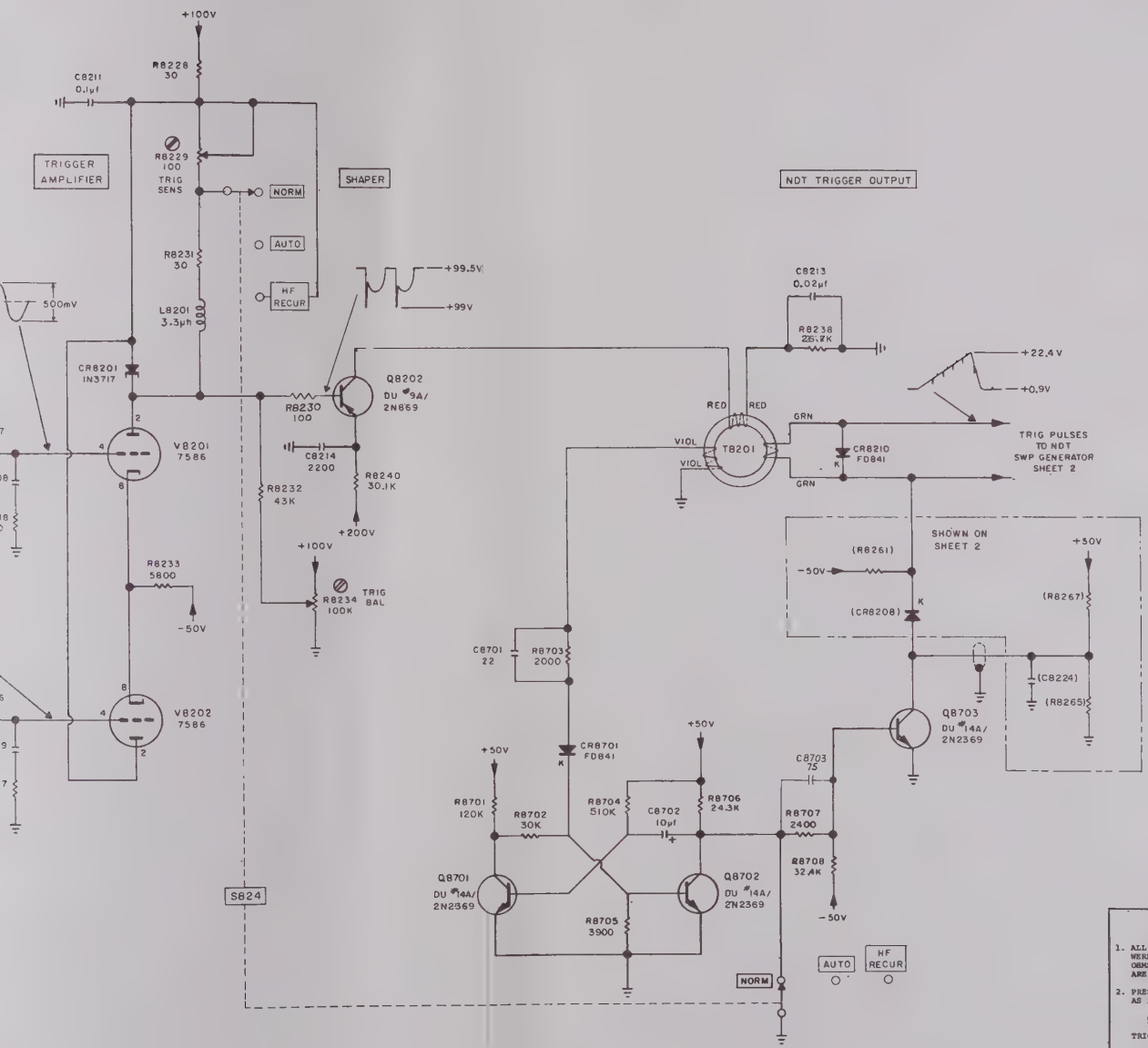
NORMAL AND DELAYING TRIGGER



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.

G CIRCUIT



AUTO TRIG CIRCUIT

VOLTAGE DATA

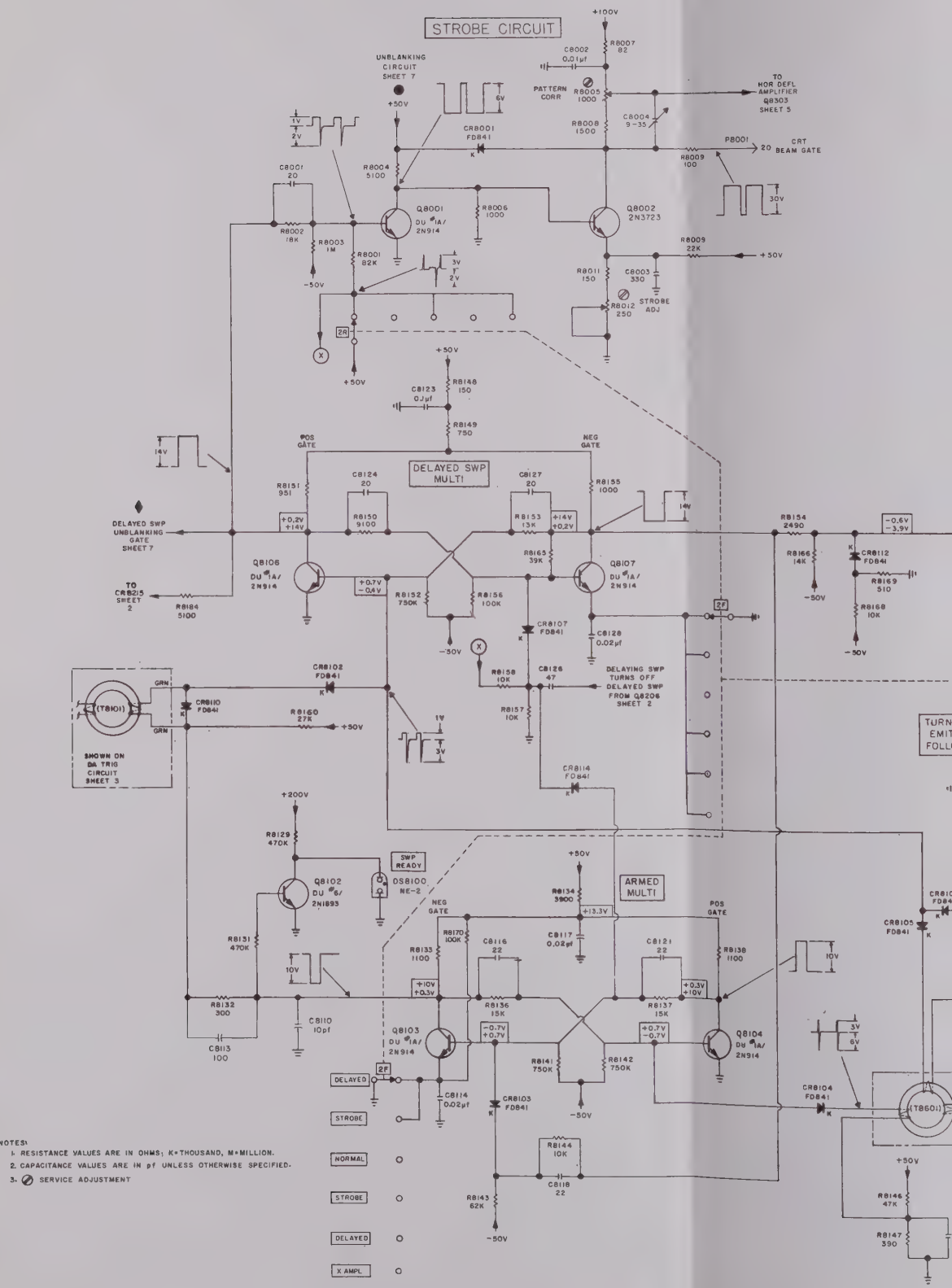
1. ALL VOLTAGE MEASUREMENTS WERE OBTAINED WITH A 20,000 OHMS/VOLT VOM; ALL READINGS ARE IN VOLTS.
2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

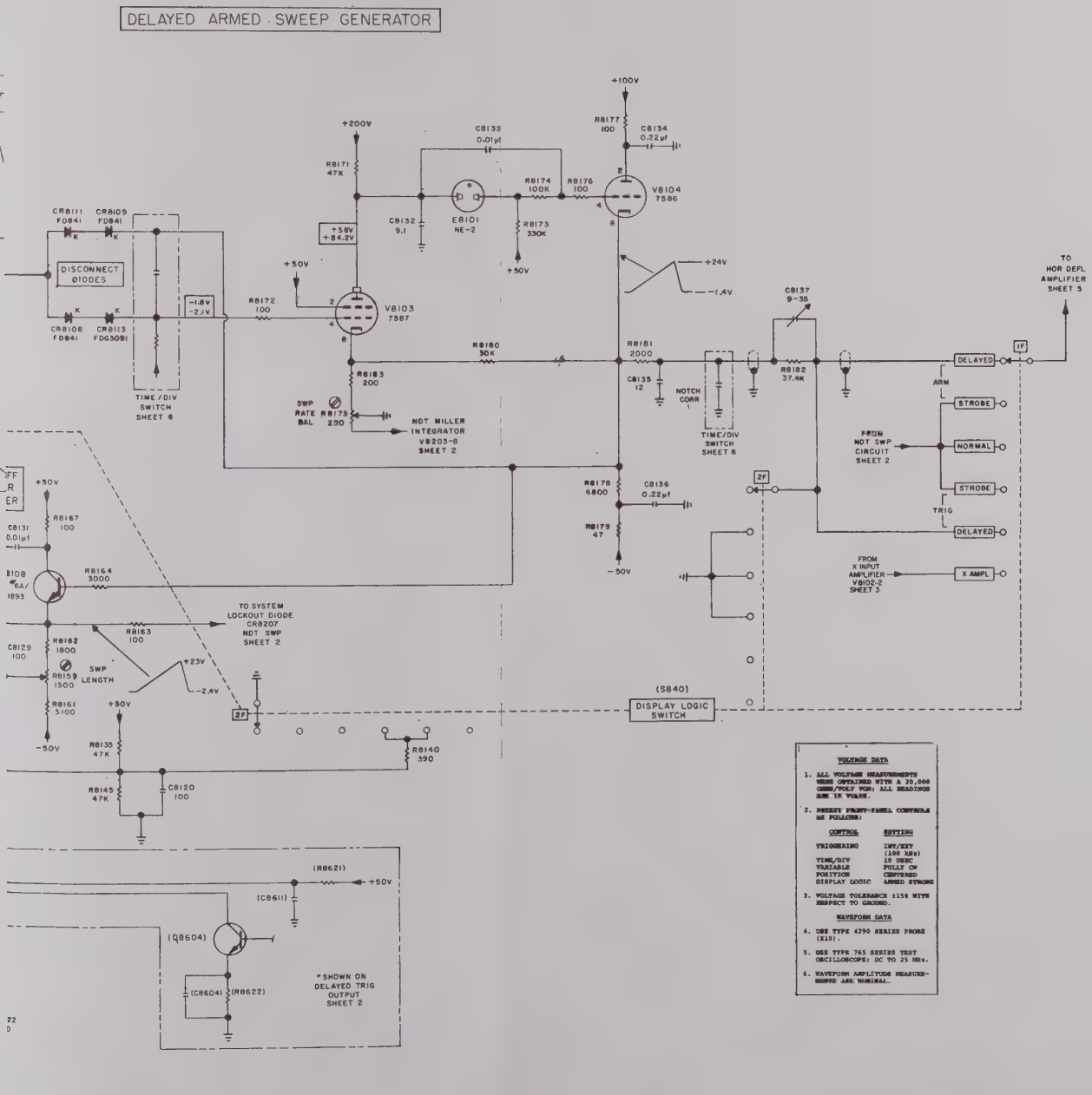
CONTROL	SETTING
TRIGGERING	INT/EXT (100 kHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

3. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.

WAVEFORM DATA

4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.


STROBE CIRCUIT
+100V
R8007 82
C8002 0.01µf
PATTERN CORR
R8005 1000
TO HOR DEFL AMPLIFIER Q8303 SHEET 5
C8004 9-35
R8008 1500
CR8001 FD841
P8001
20 CRT BEAM GATE
R8009 100
30V
UNBLANKING CIRCUIT SHEET 7
+50V
6V
1V
2V
C8001 20
R8004 5100
Q8001 DU 1A/ 2N914
R8006 1000
Q8002 2N3723
R8002 18K
R8003 1M
R8001 82K
-50V
3V
2V
R8009 22K
+50V
R8011 150
C8003 330
R8012 250
STROBE ADJ
2A
X
+50V
+50V
C8123 0.1µf
R8148 150
R8149 750
14V
POS GATE
NEG GATE
DELAYED SWP MULTI
R8151 951
C8124 20
C8127 20
R8155 1000
DELAYED SWP UNBLANKING GATE SHEET 7
+0.2V +14V
R8150 9100
R8153 13K
+14V +0.2V
14V
R8154 2490
-0.6V -3.9V
R8166 14K
CR8112 FD841
R8169 510
R8168 10K
-50V
-50V
Q8106 DU 1A/ 2N914
+0.7V -0.4V
R8165 39K
Q8107 DU 1A/ 2N914
TO CR8215 SHEET 2
R8184 5100
R8152 750K
R8156 100K
-50V
CR8107 FD841
C8128 0.02µf
2F
X
CR8102 FD841
R8158 10K
C8126 47
DELAYING SWP TURNS OFF DELAYED SWP FROM Q8206 SHEET 2
GRN
(T8601)
GRN
CR8110 FD841
R8160 27K
+50V
R8157 10K
1V
3V
SHOWN ON DA TRIG CIRCUIT SHEET 3
CR8114 FD841
TURN EMIT FOLL
+200V
R8129 470K
SWP READY
DS8100 NE-2
Q8102 DU 6/ 2N1893
+50V
R8134 3900
ARMED MULTI
+13.3V
NEG GATE
POS GATE
R8170 100K
C8116 22
C8117 0.02µf
C8121 22
R8138 1100
R8133 1100
R8131 470K
10V
10V
+10V +0.3V
+0.3V +10V
R8136 15K
R8137 15K
R8132 300
C8110 10pf
C8113 100
Q8103 DU 1A/ 2N914
-0.7V +0.7V
+0.7V -0.7V
Q8104 DU 1A/ 2N914
3V
6V
R8141 750K
R8142 750K
2F
DELAYED
STROBE
CR8103 FD841
C8114 0.02µf
-50V
CR8104 FD841
(T8601)
NORMAL
STROBE
DELAYED
X AMPL
R8144 10K
C8118 22
+50V
R8146 47K
R8143 62K
-50V
R8147 390
NOTES:
1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. SERVICE ADJUSTMENT



VOLTAGE DATA

1. ALL VOLTAGE MEASUREMENTS WERE OBTAINED WITH A 20,000 OHMS/VOLT VOM. ALL READINGS ARE IN VOLTS.
2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

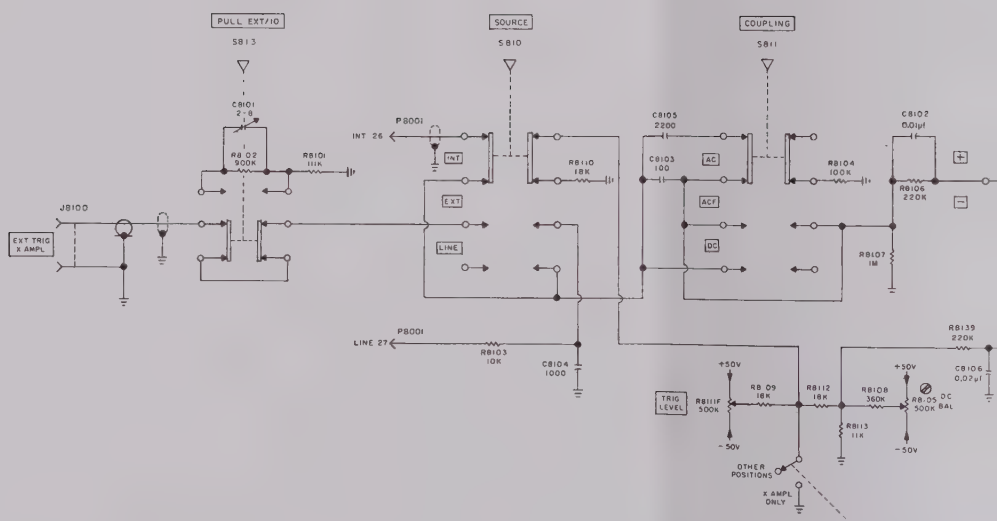
CONTROL	SETTING
TRIGGERING	INT/EXT (100 kHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

3. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.

WAVEFORM DATA

4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.

DELAYED TRIGGE



NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.

G CIRCUIT

VOLTAGE DATA

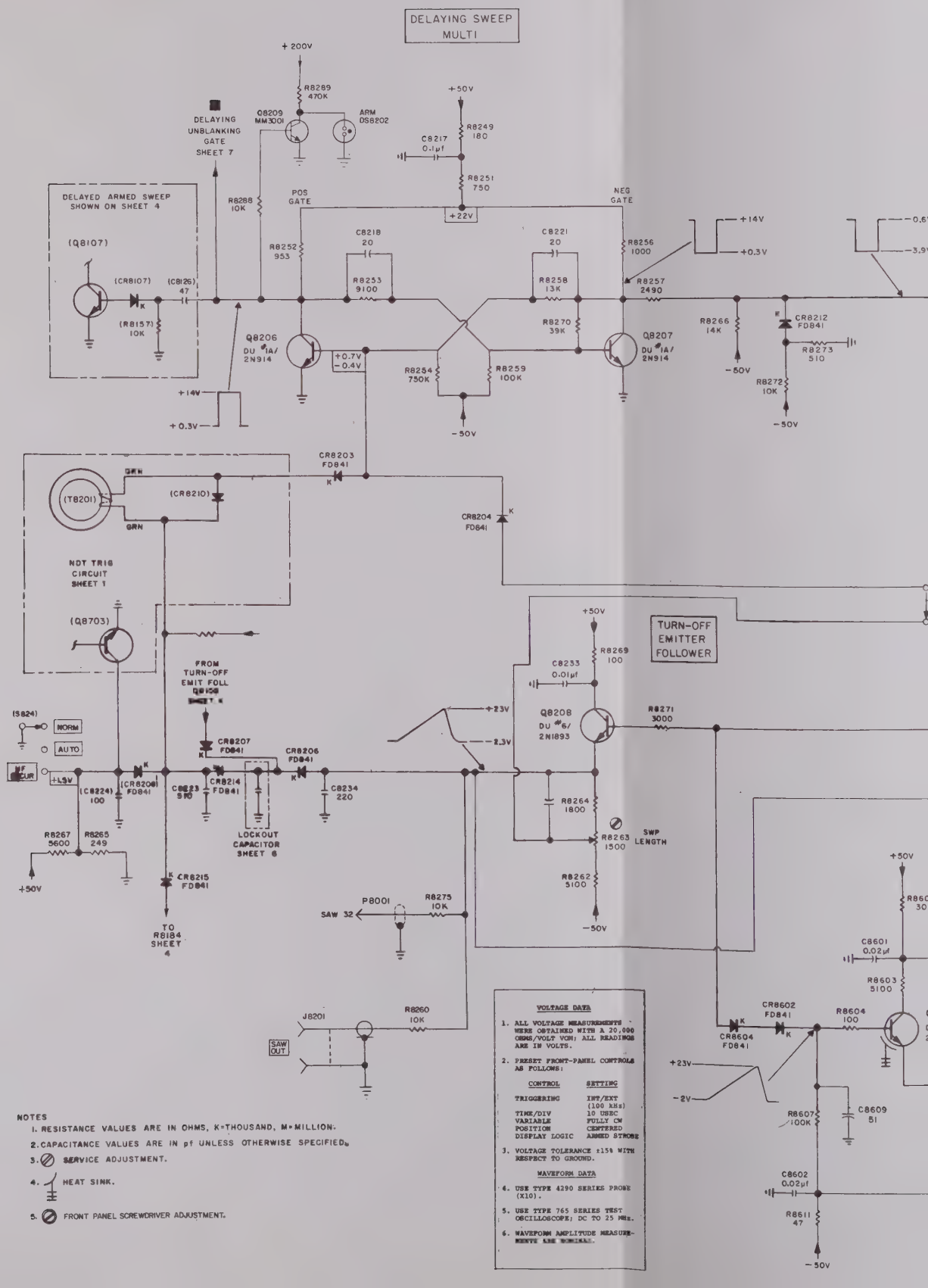
1. ALL VOLTAGE MEASUREMENTS WERE OBTAINED WITH A 20,000 OHMS/VOLT VOM; ALL READINGS ARE IN VOLTS.
2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

CONTROL	SETTING
TRIGGERING	INT/EXT (100 kHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

3. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.

WAVEFORM DATA

4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.



VOLTAGE DATA

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2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

CONTROL	SETTING
TRIGGERING	INT/EXT (100 kHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

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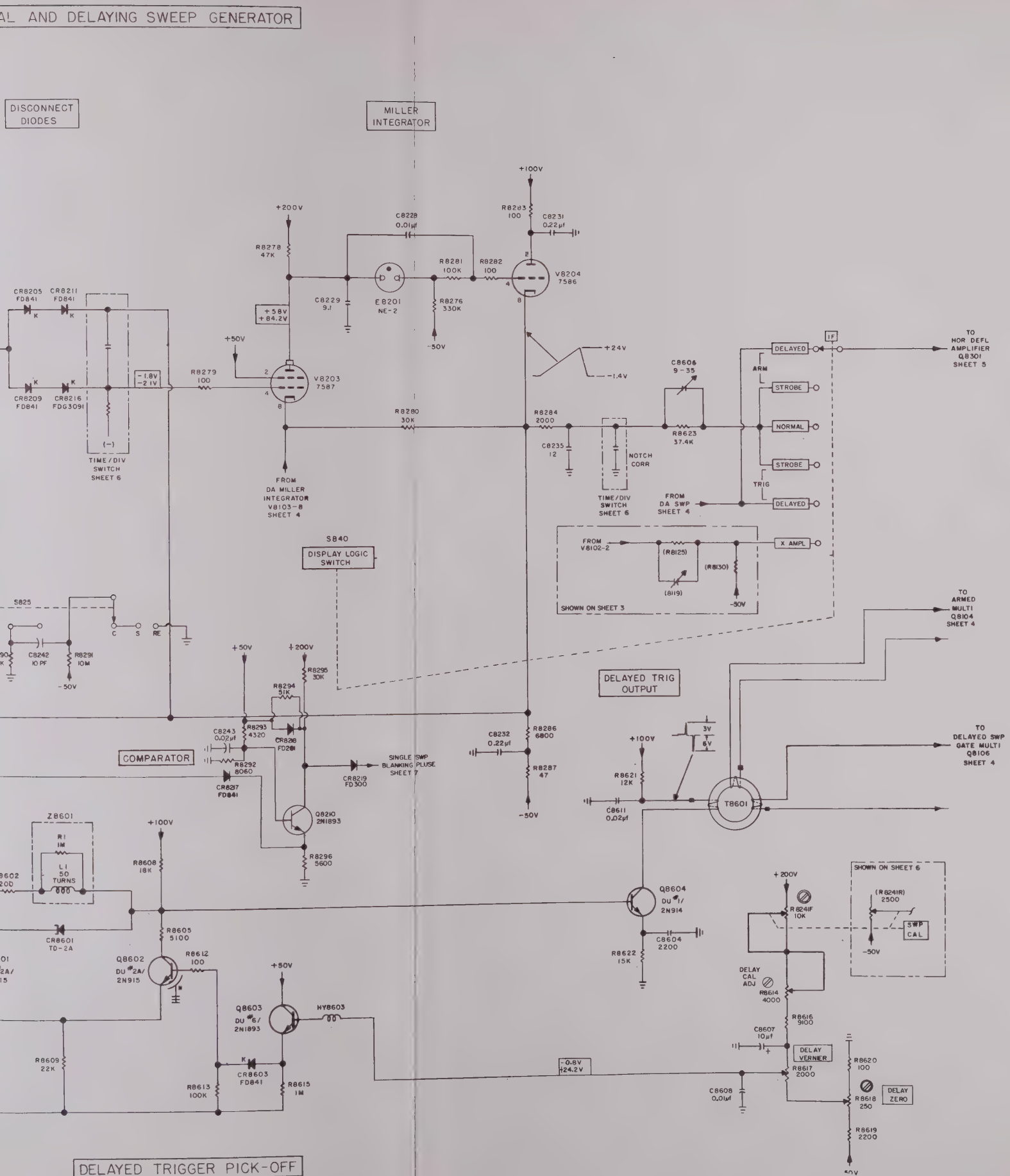
WAVEFORM DATA

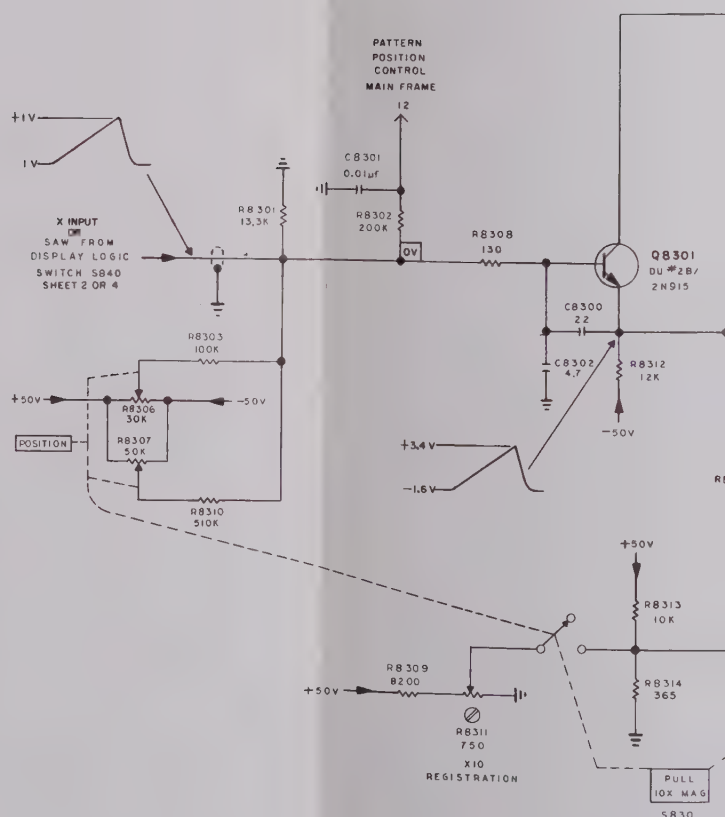
4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.

NOTES

1. RESISTANCE VALUES ARE IN OHMS, K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK.
5. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.


AL AND DELAYING SWEEP GENERATOR
DISCONNECT DIODES
MILLER INTEGRATOR
+100V
+200V
R8283 100
C8231 0.22µf
C8228 0.01µf
R8278 47K
R8281 100K
R8282 100
V8204 7586
C8229 9.1
E8201 NE-2
R8276 330K
-50V
+58V +84.2V
+50V
CR8205 FD841
CR8211 FD841
CR8209 FD841
CR8216 FD6309I
-1.8V -2.1V
R8279 100
V8203 7587
TIME/DIV SWITCH SHEET 6
FROM DA MILLER INTEGRATOR V8103-8 SHEET 4
+24V
-1.4V
C8606 9-35
R8623 37.4K
R8280 30K
R8284 2000
C8235 12
NOTCH CORR
TIME/DIV SWITCH SHEET 6
FROM DA SWP SHEET 4
DELAYED
IF
TO HOR DEFL AMPLIFIER Q8301 SHEET 5
ARM
STROBE
NORMAL
STROBE
TRIG
DELAYED
FROM V8102-2
(R8125)
(R8130)
(8119)
-50V
X AMPL
SHOWN ON SHEET 3
S840
DISPLAY LOGIC SWITCH
S825
C
S
RE
C8242 10 PF
R8291 10M
-50V
+50V
+200V
R8295 30K
R8294 51K
R8293 4320
C8243 0.02µf
R8292 8060
CR8217 FD841
CR8218 FD281
SINGLE SWP BLANKING PULSE SHEET 7
CR8219 FD300
COMPARATOR
C8232 0.22µf
R8286 6800
R8287 47
-50V
DELAYED TRIG OUTPUT
TO ARMED MULTI Q8104 SHEET 4
TO DELAYED SWP GATE MULTI Q8106 SHEET 4
3V
6V
+100V
R8621 12K
C8611 0.02µf
T8601
Z8601
R1 1M
L1 50 TURNS
+100V
R8608 18K
CR8601 TD-2A
R8605 5100
Q8602 DU*2A/ 2N915
R8612 100
Q8603 DU*6/ 2N1893
HY8603
+50V
R8609 22K
CR8603 FD841
R8613 100K
R8615 1M
Q8210 2N1893
R8296 5600
Q8604 DU*1/ 2N914
C8604 2200
R8622 15K
+200V
R8241F 10K
SHOWN ON SHEET 6
(R8241R) 2500
SWP CAL
-50V
DELAY CAL ADJ
R8614 4000
R8616 9100
C8607 10µf
DELAY VERNIER
R8617 2000
C8608 0.01µf
-0.8V +24.2V
R8620 100
R8618 250
DELAY ZERO
R8619 2200
-50V
DELAYED TRIGGER PICK-OFF

EMITTER FOLLOWER



VOLTAGE DATA

1. ALL VOLTAGE MEASUREMENTS WERE OBTAINED WITH A 20,000 OHMS/VOLT VOM; ALL READINGS ARE IN VOLTS.
2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

CONTROL	SETTING
TRIGGERING	INT/EXT (100 kHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

3. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.

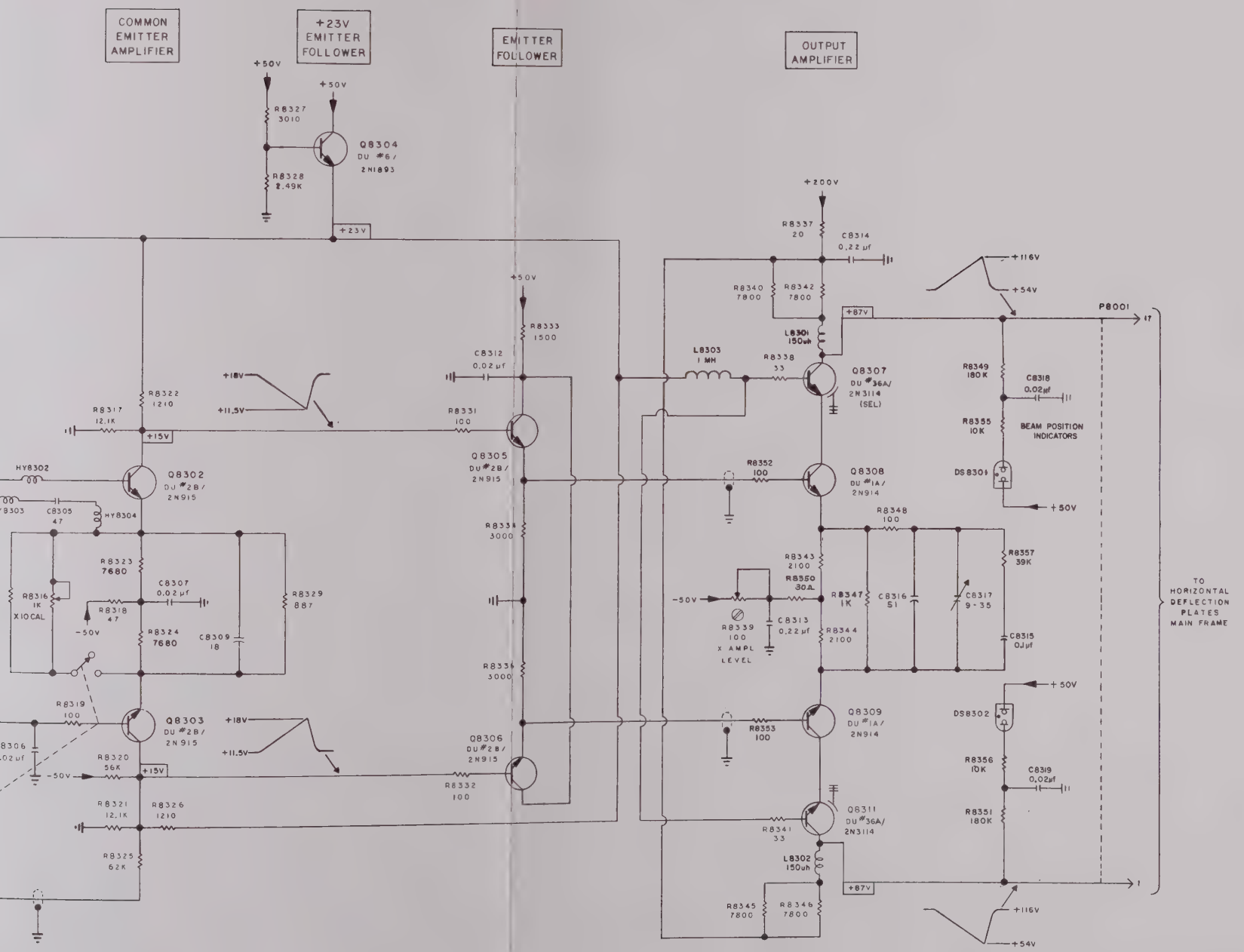
WAVEFORM DATA

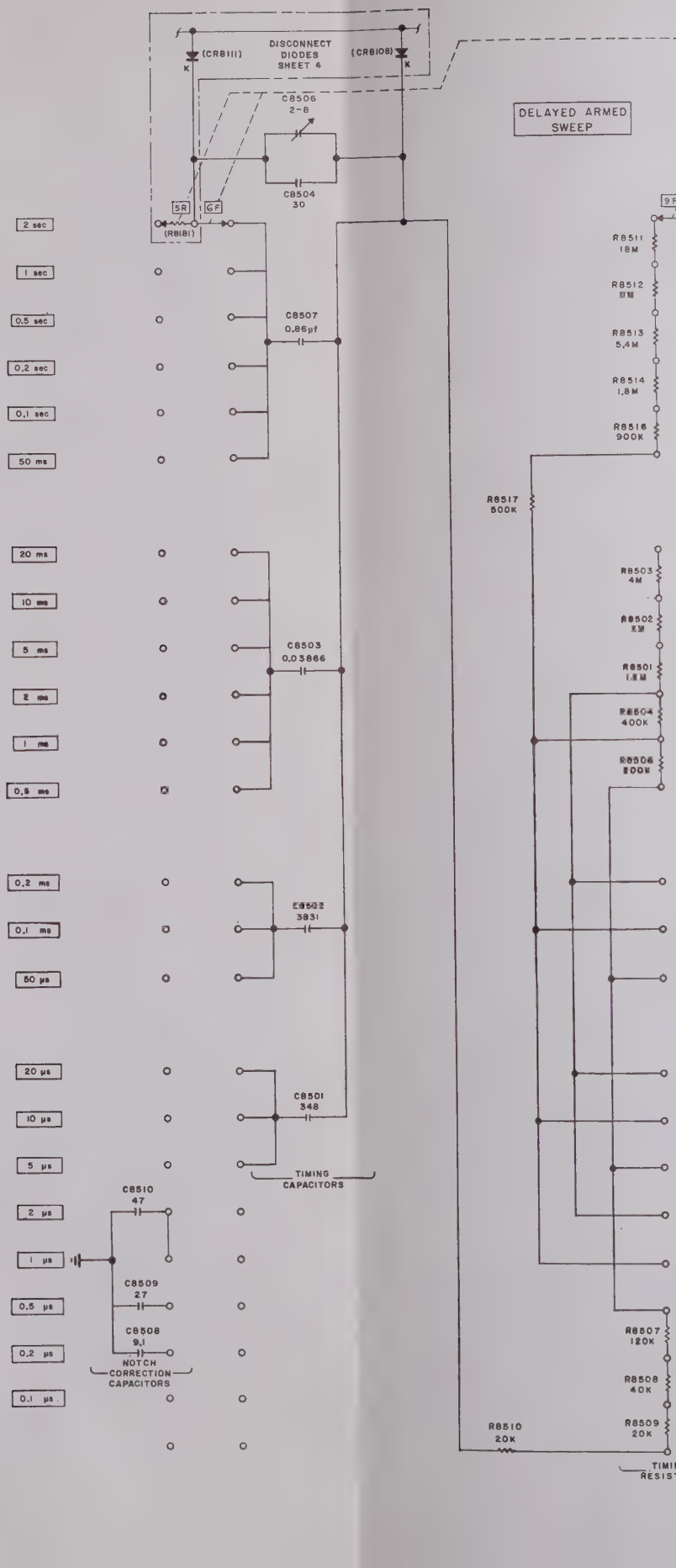
4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.

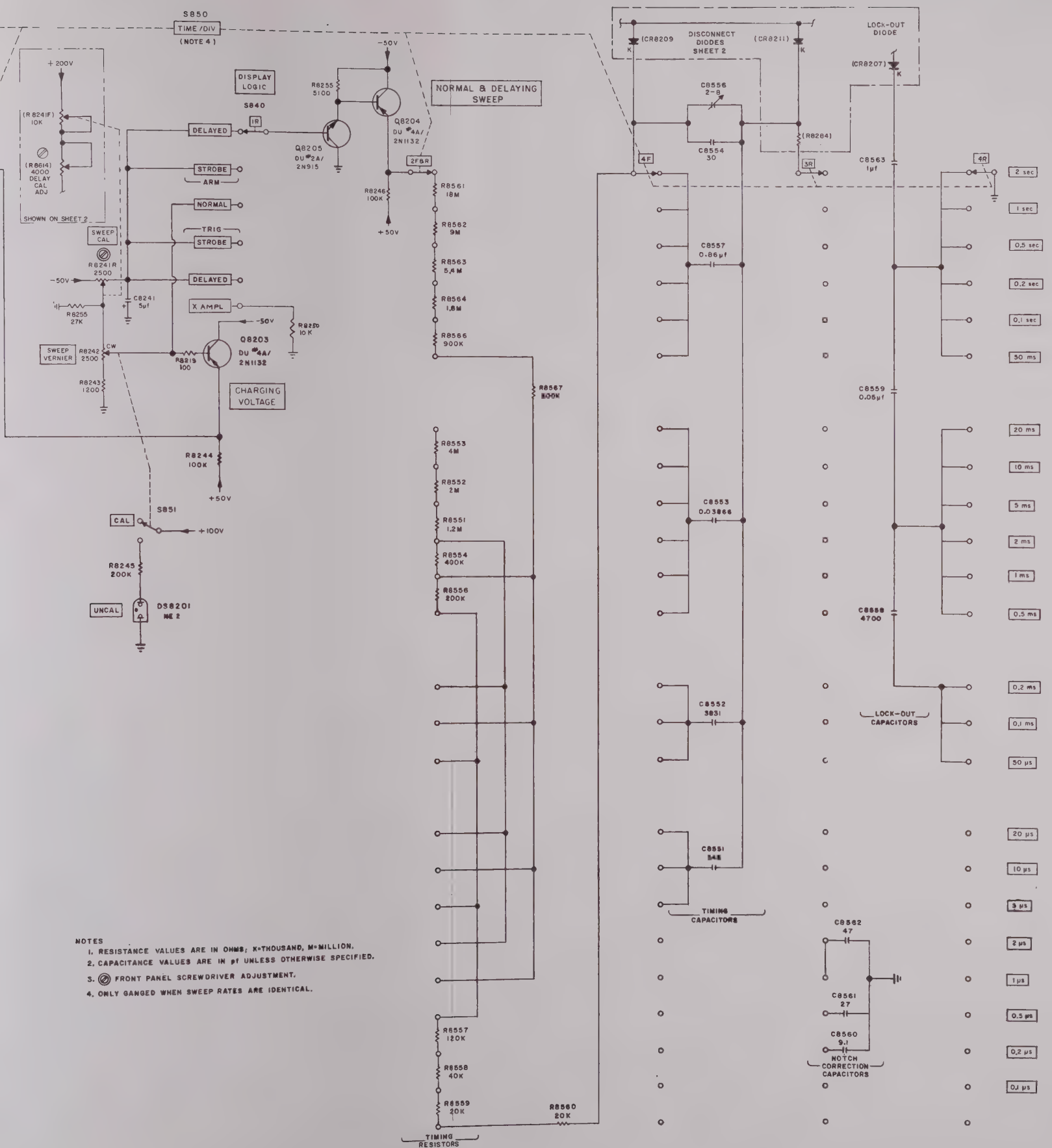
NOTES:

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ SERVICE ADJUSTMENT.
4. HEAT SINK.

HORIZONTAL DEFLECTION AMPLIFIER

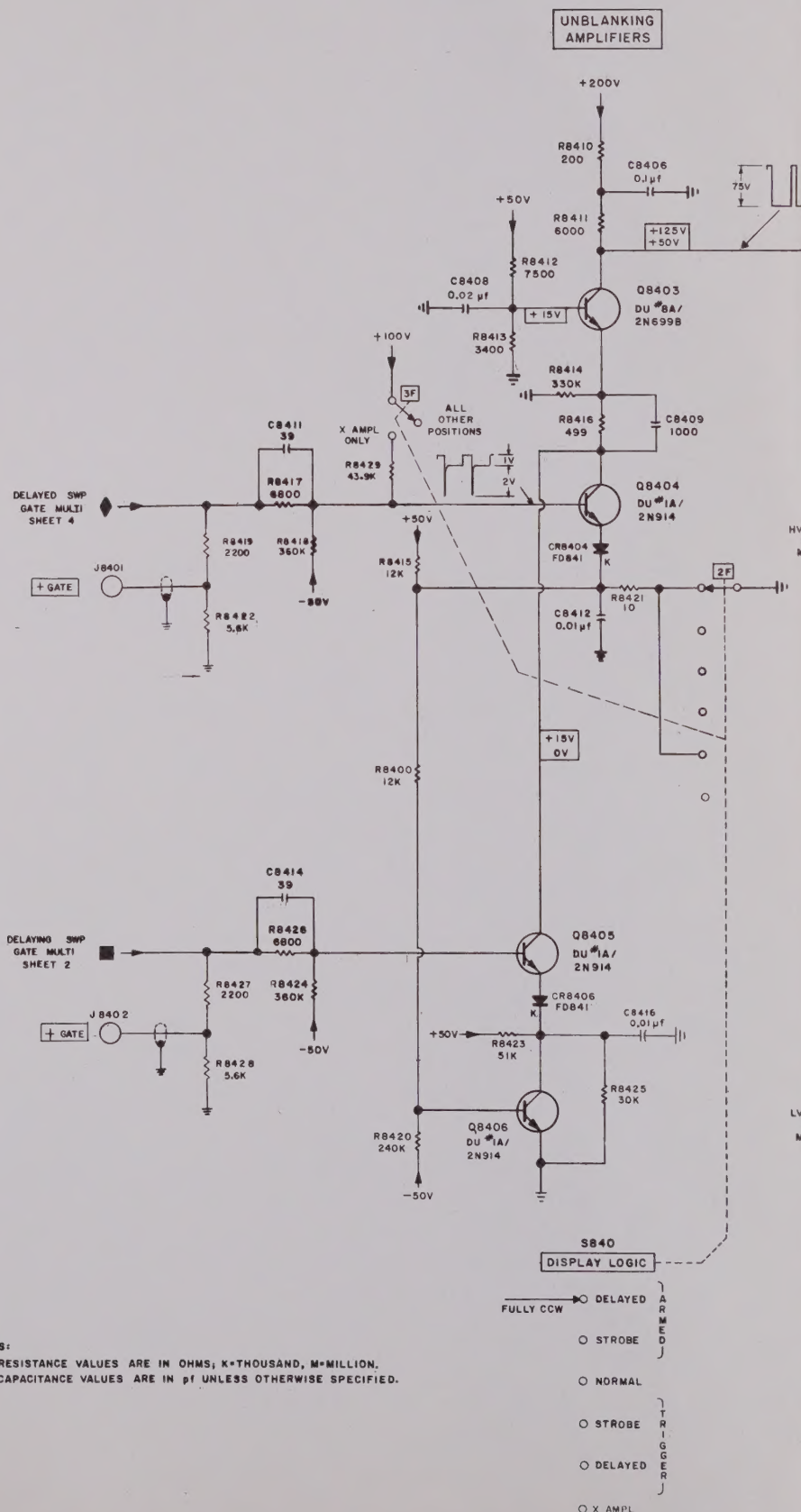



DISCONNECT DIODES SHEET 4
(CR8111)
(CR8108)
K
K
C8506 2-8
C8504 30
DELAYED ARMED SWEEP
5R
GF
(R8181)
2 sec
1 sec
0.5 sec
0.2 sec
0.1 sec
50 ms
C8507 0.86µf
20 ms
10 ms
5 ms
2 ms
1 ms
0.5 ms
C8503 0.03866
0.2 ms
0.1 ms
50 µs
C8502 3831
20 µs
10 µs
5 µs
C8501 348
TIMING CAPACITORS
2 µs
1 µs
0.5 µs
0.2 µs
0.1 µs
C8510 47
C8509 27
C8508 9.1
NOTCH CORRECTION CAPACITORS
R8511 18M
R8512
R8513 5.4M
R8514 1.8M
R8516 900K
R8517 500K
R8503 4M
R8502
R8501 1.8M
R8504 400K
R8506
R8507 120K
R8508 40K
R8509 20K
R8510 20K



NOTES

1. RESISTANCE VALUES ARE IN OHMS; K=THOUSAND, M=MILLION.
2. CAPACITANCE VALUES ARE IN pf UNLESS OTHERWISE SPECIFIED.
3. ⊘ FRONT PANEL SCREWDRIVER ADJUSTMENT.
4. ONLY GANGED WHEN SWEEP RATES ARE IDENTICAL.



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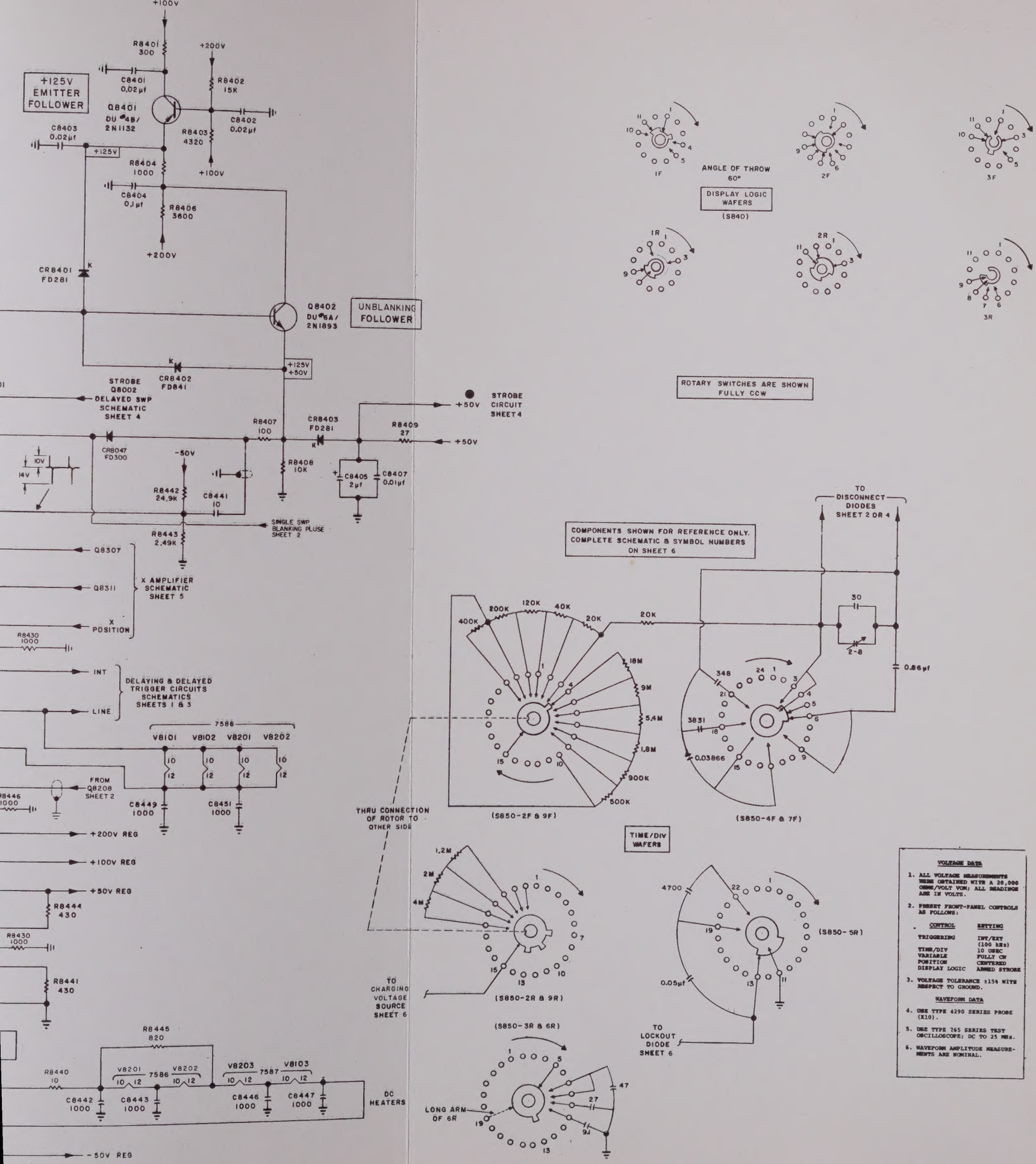

VOLTAGE DATA

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2. PRESET FRONT-PANEL CONTROLS AS FOLLOWS:

CONTROL	SETTING
TRIGGERING	INT/EXT (100 KHz)
TIME/DIV	10 USEC
VARIABLE	FULLY CW
POSITION	CENTERED
DISPLAY LOGIC	ARMED STROBE

3. VOLTAGE TOLERANCE ±15% WITH RESPECT TO GROUND.

WAVEFORM DATA

4. USE TYPE 4290 SERIES PROBE (X10).
5. USE TYPE 765 SERIES TEST OSCILLOSCOPE; DC TO 25 MHz.
6. WAVEFORM AMPLITUDE MEASUREMENTS ARE NOMINAL.

DUMONT
OSCILLOSCOPE LABORATORIES, INC.